United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Purdue University
Agricultural Experiment
Station and Indiana
Department of Natural
Resources, Soil and Water
Conservation Committee

Soil Survey of Switzerland County Indiana

HOW TO USE

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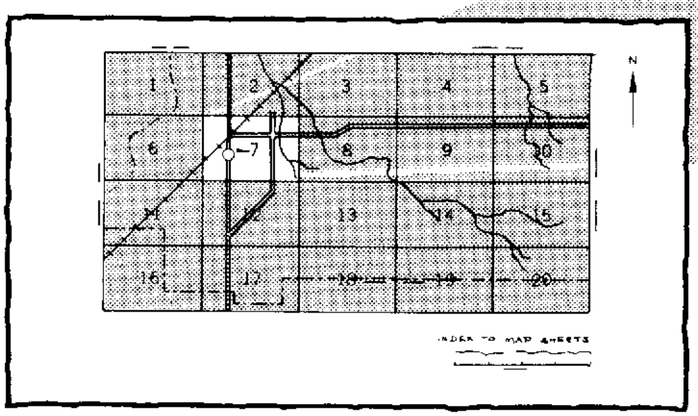

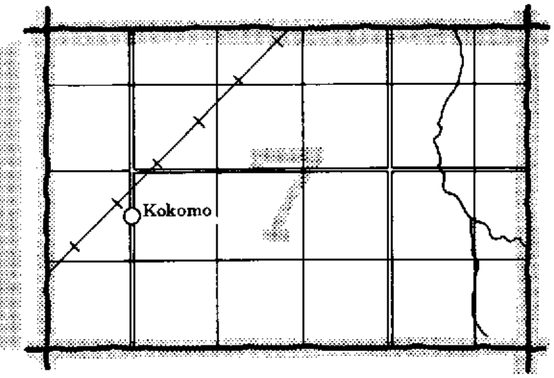

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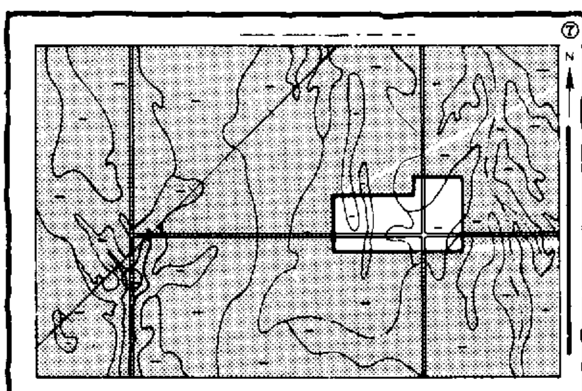

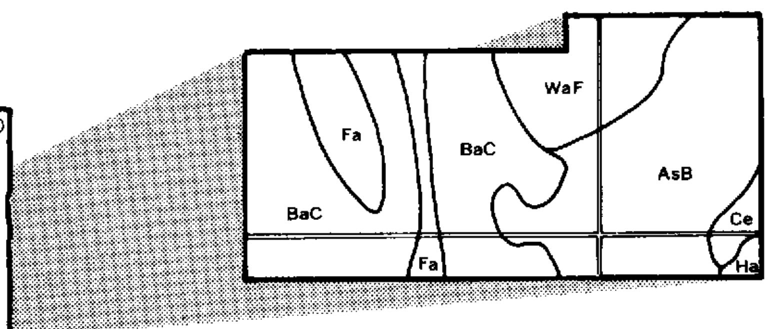

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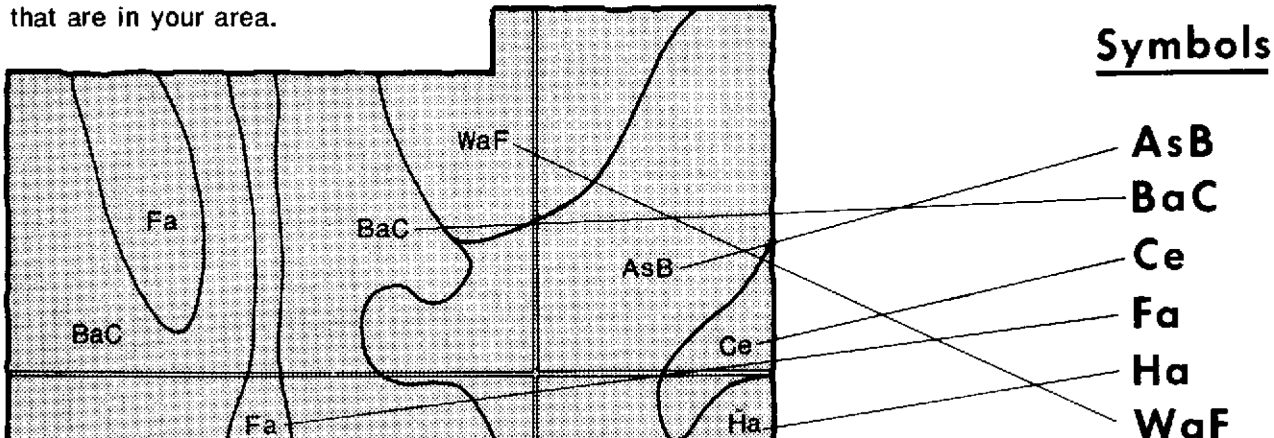
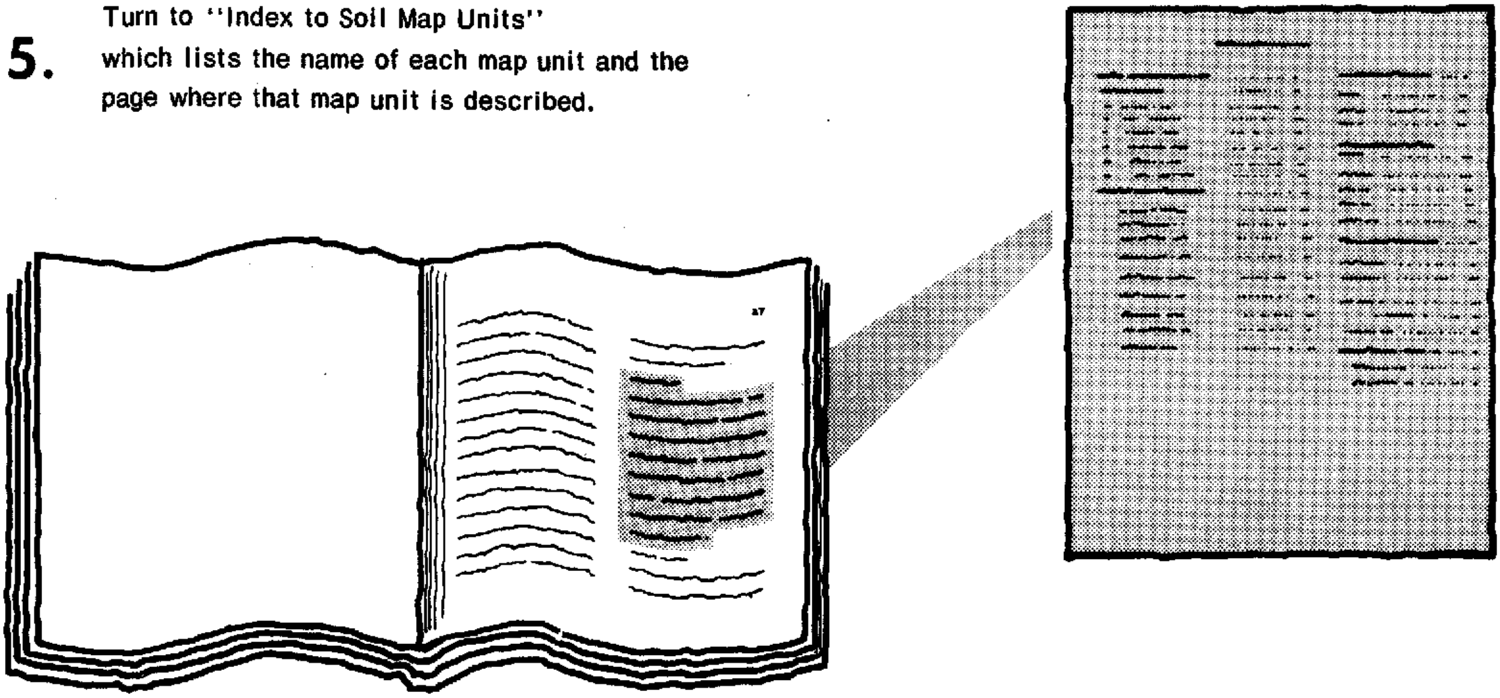
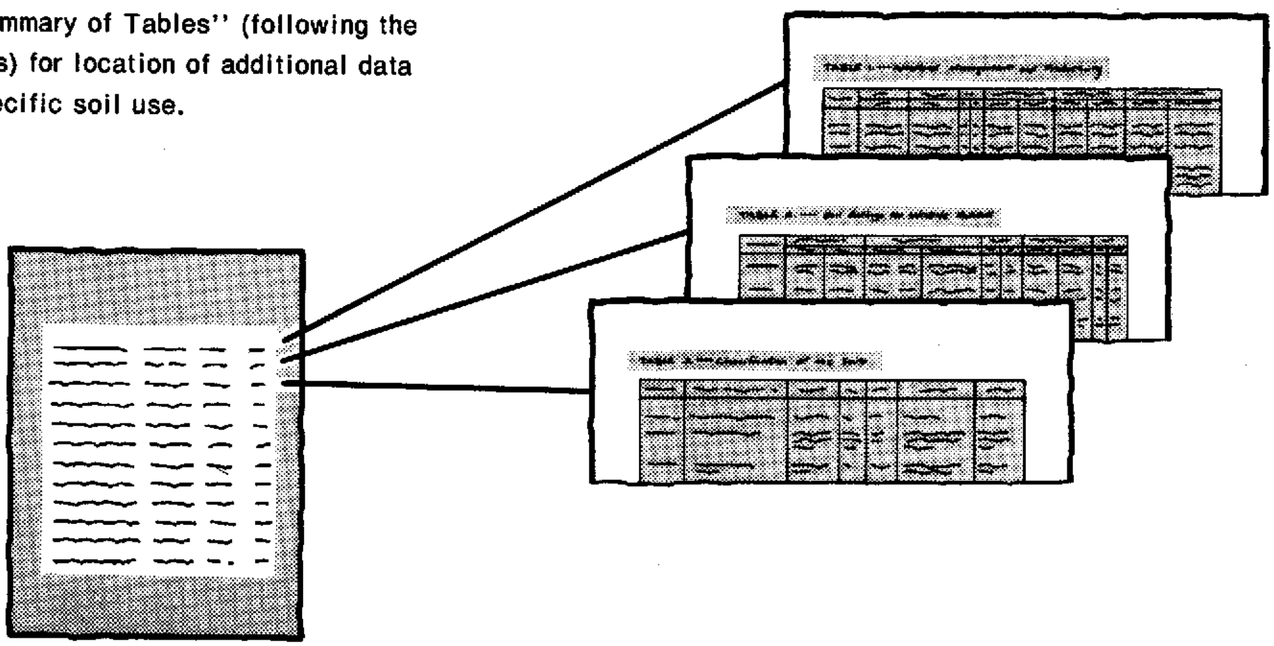


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service, the Purdue University Agricultural Experiment Station, and the Indiana Department of Natural Resources, Soil and Water Conservation Committee. It is part of the technical assistance furnished to the Switzerland County Soil and Water Conservation District. Financial assistance was made available by the Board of County Commissioners.

Cover: Fescue pasture in an area of Pate silt loam, 15 to 25 percent slopes, eroded, on a foot slope. Mixed hardwoods are on Eden flaggy silt loam, 25 to 50 percent slopes, eroded, on the upper back slope in the background.

Contents

Index to map units iv
Summary of tables v
Foreword vii
General nature of the county 1
How this survey was made 3
Map unit composition 5
Map unit descriptions 7
General soil map units 7
Broad land use considerations 11
Detailed soil map units 12
Prime farmland 39
Use and management of the soils 41
Crops and pasture 41
Woodland management and productivity 44
Windbreaks and environmental plantings 45
Recreation 45
Wildlife habitat 46
Engineering 47
Soil properties 53
Engineering index properties 53
Physical and chemical properties 54
Soil and water features 55
Engineering index test data 56
Classification of the soils 59
Soil series and their morphology 59
Formation of the soils 75
Factors of soil formation 75
Processes of soil formation 79
References 81
Glossary 83
Tables 91

Soil Series

Avonburg series 59
Bloomfield series 60
Bonnell series 61
Carmel series 62
Chagrin series 62
Cincinnati series 63
Cobbsfork series 63
Dearborn series 65
Eden series 65
Elkinsville series 66
Huntington series 66
Markland series 67
Newark series 68
Pate series 68
Pekin series 69
Rossmoyne series 69
Switzerland series 70
Weisburg series 71
Wheeling series 72
Woolper series 72

Issued July 1987

Index to Map Units

AvA—Avonburg silt loam, 0 to 2 percent slopes 12
AvB2—Avonburg silt loam, 2 to 4 percent slopes, eroded 13
BmC—Bloomfield loamy fine sand, 4 to 12 percent slopes 14
BoC2—Bonnell silty clay loam, 6 to 12 percent slopes, eroded 15
BoE2—Bonnell silty clay loam, 15 to 25 percent slopes, eroded 15
CaC2—Carmel silty clay loam, 6 to 12 percent slopes, eroded 16
CaC3—Carmel silty clay loam, 6 to 12 percent slopes, severely eroded 16
Ch—Chagrin silt loam, occasionally flooded 18
CnB2—Cincinnati silt loam, 2 to 6 percent slopes, eroded 19
CnC2—Cincinnati silt loam, 6 to 12 percent slopes, eroded 19
CnC3—Cincinnati silt loam, 6 to 12 percent slopes, severely eroded 21
Co—Cobbsfork silt loam 21
Dn—Dearborn loam, frequently flooded 22
Dr—Dearborn channery silt loam, frequently flooded. 22
EdF2—Eden flaggy silt loam, 25 to 50 percent slopes, eroded 23
EeE2—Eden silty clay loam, 15 to 50 percent slopes, eroded 24
EkA—Elkinsville silt loam, rarely flooded, 0 to 2 percent slopes 24
EkB—Elkinsville silt loam, rarely flooded, 2 to 8 percent slopes 25
Hu—Huntington silt loam, occasionally flooded 26
MaB2—Markland silt loam, 1 to 6 percent slopes, eroded 27
MaC2—Markland silt loam, 8 to 15 percent slopes, eroded 27
Ne—Newark silt loam, occasionally flooded 28
PaE2—Pate silt loam, 15 to 25 percent slopes, eroded 28
PkB—Pekin silt loam, rarely flooded, 1 to 4 percent slopes 30
RoA—Rossmoyne silt loam, 0 to 2 percent slopes 30
RoB2—Rossmoyne silt loam, 2 to 6 percent slopes, eroded 32
SwB2—Switzerland silt loam, 2 to 6 percent slopes, eroded 32
SwC2—Switzerland silt loam, 6 to 12 percent slopes, eroded 33
Ud—Udorthents, loamy 34
WgB2—Weisburg silt loam, 2 to 6 percent slopes, eroded 35
WgC2—Weisburg silt loam, 6 to 12 percent slopes, eroded 36
WhA—Wheeling loam, rarely flooded, 0 to 2 percent slopes 36
WhB—Wheeling loam, rarely flooded, 2 to 8 percent slopes 37
WhC—Wheeling loam, rarely flooded, 8 to 15 percent slopes 38
WhE—Wheeling loam, rarely flooded, 18 to 35 percent slopes 38
WvC—Woolper silty clay loam, 3 to 10 percent slopes 39

Summary of Tables

Temperature and precipitation (table 1) 92

Freeze dates in spring and fall (table 2) 93
Probability. Temperature.

Growing season (table 3) 93

Acreage and proportionate extent of the soils (table 4) 94
Acres. Percent.

Prime farmland (table 5) 95

Land capability classes and yields per acre of crops and pasture (table 6) 96
Land capability. Corn. Soybeans. Winter wheat. Orchardgrass-red clover hay. Tall fescue.

Capability classes and subclasses (table 7) 98
Total acreage. Major management concerns.

Woodland management and productivity (table 8) 99
Ordination symbol. Management concerns. Potential productivity. Trees to plant.

Windbreaks and environmental plantings (table 9) 103

Recreational development (table 10) 106
Camp areas. Picnic areas. Playgrounds. Paths and trails. Golf fairways.

Wildlife habitat (table 11) 108
Potential for habitat elements. Potential as habitat for—Openland wildlife, Woodland wildlife, Wetland wildlife.

Building site development (table 12) 110
Shallow excavations. Dwellings without basements. Dwellings with basements. Small commercial buildings. Local roads and streets. Lawns and landscaping.

Sanitary facilities (table 13) 113
Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.

Construction materials (table 14) 116
Roadfill. Sand. Gravel. Topsoil.

Water management (table 15) 118
Limitations for—Pond reservoir areas; Embankments, dikes, and levees; Aquifer-fed excavated ponds. Features affecting—Drainage, Terraces and diversions, Grassed waterways.

Engineering index properties (table 16) 120
Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve number—4, 10, 40, 200. Liquid limit. Plasticity index.
Physical and chemical properties of the soils (table 17) 123
Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Shrink-swell potential. Erosion factors. Wind erodibility group. Organic matter.
Soil and water features (table 18).. 125
Hydrologic group. Flooding. High water table. Bedrock. Potential frost action. Risk of corrosion.
Engineering index test data (table 19) 127
Parent material. Report number. Depth. Moisture density. Percentage passing sieve—No. 4, No. 10, No. 40, No. 200. Percentage smaller than—0.05 millimeter, 0.02 millimeter, 0.005 millimeter, 0.002 millimeter. Liquid limit. Plasticity index. Classification—AASHTO, Unified.
Classification of the soils (table 20).. 128
Family or higher taxonomic class.

Foreword

This soil survey contains information that can be used in land-planning programs in Switzerland County, Indiana. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Robert L Eddleman

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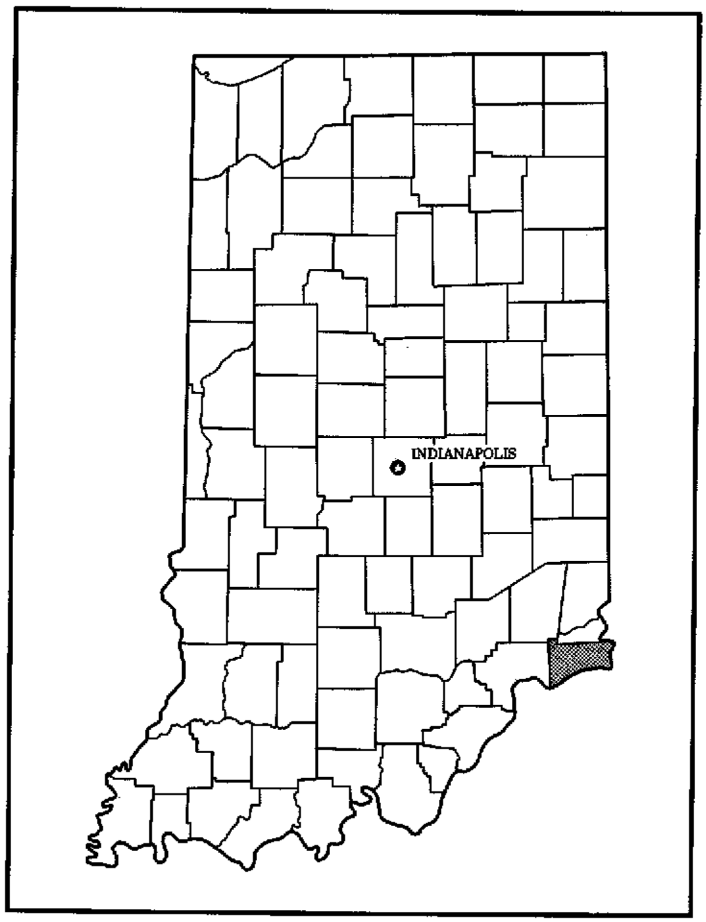

Location of Switzerland County in Indiana.

Soil Survey of Switzerland County, Indiana

By Allan K. Nickell, Soil Conservation Service

Fieldwork by Allan K. Nickell, Soil Conservation Service, and
Terry L. Stephenson, Indiana Department of Natural Resources,
Soil and Water Conservation Committee

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Purdue University Agricultural Experiment Station and Indiana Department
of Natural Resources, Soil and Water Conservation Committee

SWITZERLAND COUNTY is in the southeastern part of Indiana. It has an area of 143,104 acres, or 223.6 square miles (*7*). It extends about 16 miles from north to south and 22 miles from east to west. The Ohio River borders the county on the south and east. Vevay, which is situated along the river, is the county seat.

This soil survey updates the survey of Switzerland County published in 1930 (*4*). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information about some of the physical and cultural features of Switzerland County. These features are history and development; climate; physiography, relief, and drainage; water supply; industry and transportation facilities; trends in population and land use; and farming.

History and Development

The early inhabitants of the area now known as Switzerland County were probably nomadic hunters. Artifacts, such as arrowheads, hint of more recent Indian inhabitants.

The first log cabin in the area was built in 1795, along Plum Creek. The area officially became Switzerland County in 1814. Vevay was laid out in 1813 and was incorporated as a town in 1836 (*3*). It flourished during the steamboat era, when it was a major political, cultural, and economic center. It declined in importance with the advent of the railroads, which bypassed the county.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Madison, Indiana, in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 35 degrees F, and the average daily minimum temperature is 26 degrees. The lowest temperature on record, which occurred at Madison on February 2, 1951, is -12 degrees. In summer the average temperature is 76 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Madison on July 15, 1954, is 108 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 42 inches. Of this, 22 inches, or about 52 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 4 inches at Madison on June 23, 1960. Thunderstorms occur on about 50 days each year. Tornadoes and severe thunderstorms strike occasionally. These storms are usually local in extent and of short duration and cause damage in scattered areas.

The average seasonal snowfall is about 13 inches. The greatest snow depth at any one time during the period of record was 12 inches. On the average, 1 day of the year has at least 1 inch of snow on the ground.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 10 miles per hour, in spring.

Physiography, Relief, and Drainage

Relief in Switzerland County is influenced by two major waterways—the Ohio River and Indian Creek. The area that is drained by the Ohio River is characterized by sloping ridges and steep hillsides (fig. 1). Low lying areas in Vevay, Patriot, and Florence, which are situated near the Ohio River, are occasionally flooded.

The Indian Creek watershed has generally broad, gently sloping ridges and moderately steep hillsides. A major tributary of the Ohio River in Switzerland County, this creek drains the western half of the county. It meanders through a broad valley that has many terraces. Numerous smaller creeks, such as Grants, Bryant, and Plum Creeks, flow into the Ohio River. Other tributaries of the Ohio River include Turtle Creek and Goose Creek.

The highest point in the county is 980 feet above sea level. It is near the northwest corner of the county. The lowest point is approximately 450 feet above sea level. It is in an area along the Ohio River.

Water Supply

Public or private utilites provide water to half of the occupied housing units in Switzerland County. All of this water is pumped from deep wells located in deposits of sand and gravel in the valley of the Ohio River. The

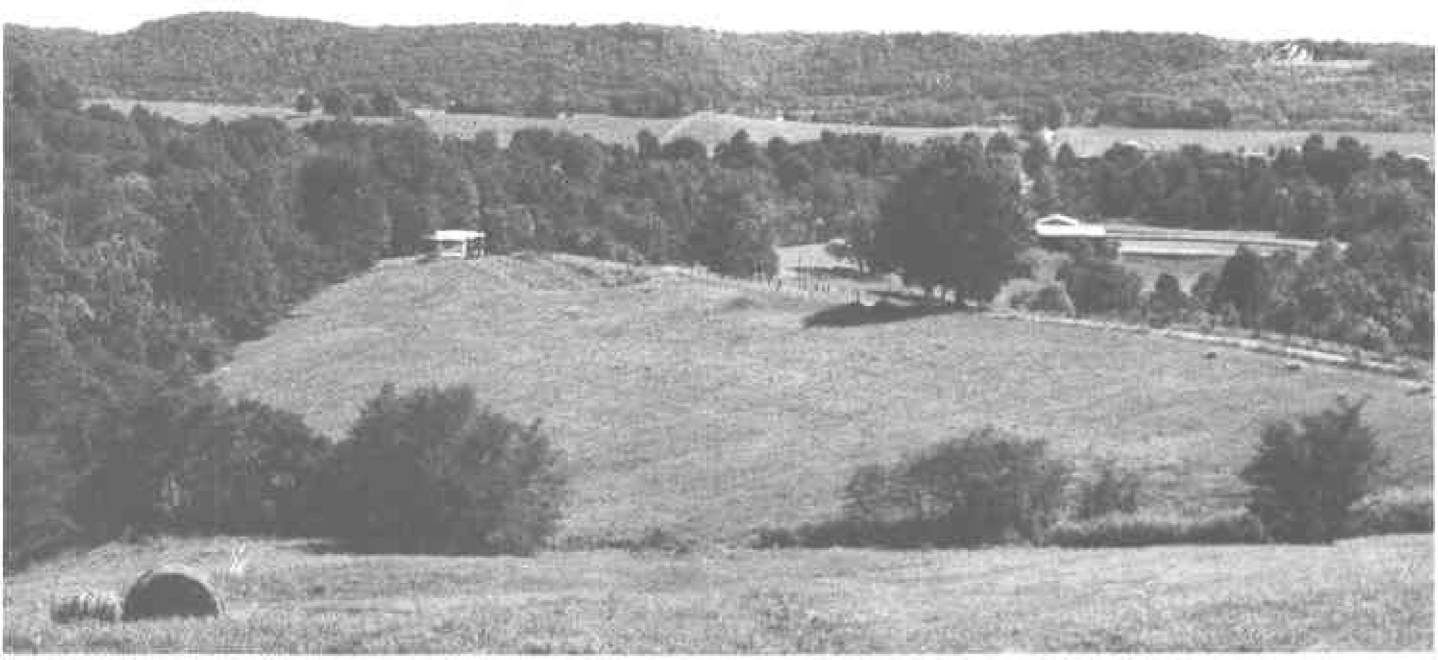

Figure 1.—An area of Weisburg silt loam, 6 to 12 percent slopes, eroded, on ridges and Eden silty clay loam, 15 to 50 percent slopes, eroded, on hillsides.

water is stored in tanks or reservoirs and distributed throughout the county by public rural water lines.

A pumping station at Vevay has a capacity of 605,000 gallons per day. It serves 750 customers. The Patriot Water Company serves about 2,300 customers. Its daily capacity is about 700,000 gallons.

In areas where it is not available through public water lines, water is obtained from dug wells, drilled wells, springs, cisterns, ponds, creeks, or the Ohio River. The best source of water for wells is the Silurian dolomitic limestone and shaly bedrock in the northwestern part of the county. The Ordovician shale and limestone bedrock in the eastern and southern parts generally are not water bearing. Wells in these areas often contain saline or sulfuric water if they contain any water at all. In many places the flow from springs is not sufficient for both domestic and farm uses. When the amount of rainfall is low, dug wells and cisterns may become dry. Small ponds and reservoirs are used to supplement the water from springs, wells, and cisterns. Many farm ponds and lakes have been built to meet farm needs.

Industry and Transportation Facilities

A few industries are established in Switzerland County. These include manufacturers of shoes, automotive trim, chain-saw casings, and trim for household appliances and a plastic-molding plant. Businesses within the county employ about 10 percent of the working population in the county. About 25 percent of the work force is engaged in manufacturing.

The main roads in Switzerland County are State Roads 56, 156, 129, and 250. A bridge near Markland is the only bridge across the Ohio River between Madison and Lawrenceburg.

Trends in Population and Land Use

Switzerland County has a total population of about 6,600 and a population density of 29 people per square mile. The population increased by only 300 between 1970 and 1980. It is expected to reach 7,400 by the year 2000 (*6*).

The acreage used for agricultural purposes has been gradually decreasing as more and more land is developed for other purposes (*10*). In 1982, an estimated 3,700 acres was used for purposes other than agriculture or forestry. Of this acreage, about 700 acres was urban or built-up land (*11*). The rest occurred as areas used for roads, water areas, gravel pits, quarries, and areas used for other miscellaneous types of development. The acreage used for urban and other miscellaneous types of development has been increasing at the rate of about 14 acres per year.

Approximately 1,000 acres along the Ohio River is federal land. This land is around the Markland Dam and in the several backwater areas above the dam. It generally is idle land (*6*).

Farming

Most of the acreage in the county is used for hay and pasture. Tobacco, corn, soybeans, wheat, and hay are the principal crops. Most hay fields and pastures are sown with fescue, red clover, and some alfalfa. Vegetable crops are grown commercially in numerous small areas. These crops include sweet corn, snap beans, potatoes, tomatoes, and pumpkins.

The livestock on the farms in the county include cattle, hogs, dairy cows (fig. 2), and a few sheep (*10*). A major egg farm is in the southeastern part of the county.

The number of farms in the county increased from 736 in 1974 to 762 in 1978. The average size of the farms also increased, from 126 to 129 acres (*10*). The number of full-time farm owners has decreased. Absentee landowners own about half of the farms in the county. Many of these farms are rented or leased to local farmers.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship,

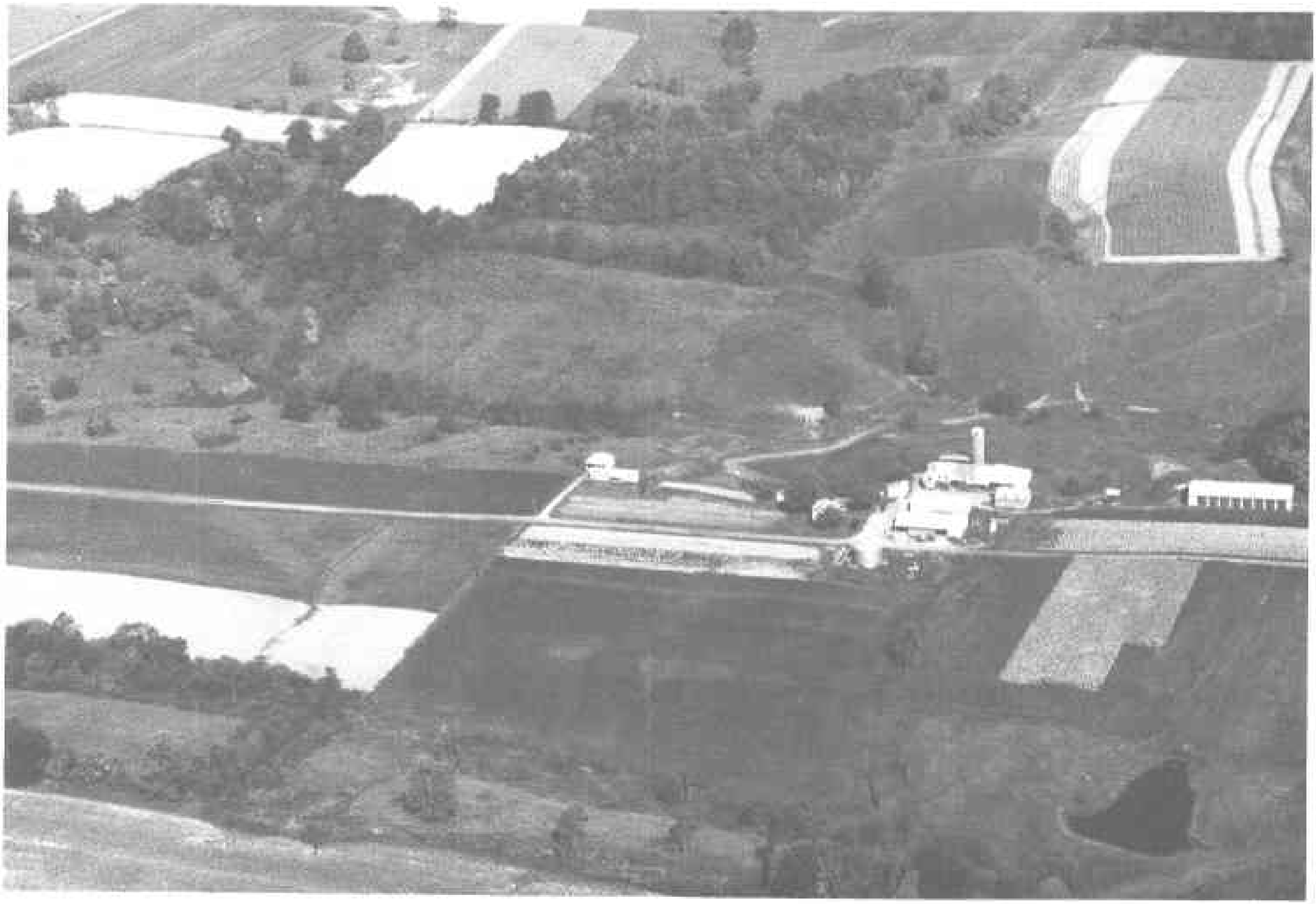

Figure 2.—A dairy farm in an area of Cincinnati silt loam, 2 to 6 percent slopes, eroded, and Rossmoyne silt loam, 0 to 2 percent slopes.

are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Map Unit Descriptions

This section describes the map units in the survey area at two levels of detail. The general soil map units are described first and then the detailed map units. Most of the general soil map units represent the soils of major extent in the survey area. The detailed map units represent all of the named soils in the survey area.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The names, descriptions, and delineations of the soils identified on the general soil map of this county do not always agree or join fully with those of the soils identified on the maps of adjoining counties published at an earlier date. Some differences are the result of changes in concepts of soil series. Other differences result from variations in the extent of the soils. Others are a result of variations in the slope range allowed in the map units.

1. Huntington-Wheeling

Deep, nearly level to steep, well drained soils formed in silty and loamy alluvium; on bottom land and terraces

These soils are nearly level on bottom land and nearly level to steep on terraces along the Ohio River.

This map unit makes up about 7 percent of the county. It is about 38 percent Huntington soils, 34 percent Wheeling soils, and 28 percent soils of minor extent (fig. 3).

The nearly level Huntington soils are on bottom land along the Ohio River and its larger tributaries. Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsoil is dark brown and yellowish brown, firm silty clay loam in the upper part and dark yellowish brown, friable silt loam in the lower part.

The nearly level to steep Wheeling soils are on terraces along the Ohio River, in the eastern part of the county. Typically, the surface layer is dark brown loam about 11 inches thick. The subsoil is strong brown, friable loam. The substratum is yellowish brown fine sandy loam.

Minor in this map unit are the Elkinsville and Markland soils. The deep, well drained Elkinsville soils are on terraces along the Ohio River. They have less sand and more silt in the lower part of the subsoil than the major soils. The deep, well drained and moderately well drained Markland soils are on lacustrine terraces. They have more clay in the subsoil than the major soils.

This map unit is used mainly for cultivated crops, pasture, or urban development. The main crops are corn, soybeans, and small grain.

This map unit is suited to cultivated crops and pasture. The main hazards are flooding on the bottom land and erosion on the more sloping terraces. The unit is generally unsuited to urban uses because the flooding is a severe hazard. The suitability for the more intensive recreational uses is good.

2. Avonburg-Cobbsfork

Deep, nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in a thin mantle of loess and in the underlying glacial drift; on uplands

These soils are on glacial drift plains that are characterized by smooth topography. Areas are few but are fairly large.

This map unit makes up about 6 percent of the county. It is about 42 percent Avonburg soils, 34 percent Cobbsfork soils, and 24 percent soils of minor extent (fig. 4).

The nearly level and gently sloping, somewhat poorly drained Avonburg soils are on relatively broad tabular divides and the upper back slopes. They have a seasonal high water table. They also have a very slowly permeable fragipan. Typically, the surface layer is dark brown silt loam about 9 inches thick. In sequence downward, the subsoil is yellowish brown, mottled, friable silt loam; light brownish gray, mottled, firm, brittle silty clay loam; a fragipan of light brownish gray and gray, mottled, very firm, brittle silty clay loam; and yellowish brown, firm, brittle silty clay loam.

The nearly level, poorly drained Cobbsfork soils are on the broadest tabular divides where the glacial drift is thickest and the elevation is highest in the county. They have a seasonal high water table. Typically, the surface layer is grayish brown, mottled silt loam about 6 inches thick. The subsoil is silt loam. It is light brownish gray and friable in the upper part; gray, firm, and brittle in the next part; and gray, mottled, very firm, and brittle in the lower part.

Minor in this map unit are the deep Rossmoyne and Cincinnati soils. These soils have fewer grayish mottles in the upper part of the subsoil than the major soils. The moderately well drained Rossmoyne soils are on summits, shoulder slopes, and the upper back slopes. The well drained Cincinnati soils are on summits, shoulder slopes, and back slopes.

This map unit is used mainly for cultivated crops. Some areas are used for pasture or are wooded. A surface drainage system has been installed in most of the cultivated areas. The main crops are corn, soybeans, and small grain.

Although wetness is a limitation, this map unit is suited to cultivated crops. It is generally unsuited to urban uses because the wetness is a severe limitation. An adequate drainage system should be the first management consideration if areas are to be used for urban development. The suitability for the more intensive recreational uses is poor because of the wetness.

3. Cincinnati-Weisburg-Bonnell

Deep, gently sloping to moderately steep, well drained soils formed in a thin mantle of loess and in the underlying glacial drift and clayey material weathered from limestone and calcareous shale; on uplands

These soils are on uplands characterized by rolling topography. Areas are fairly large and are throughout the county.

This map unit makes up about 28 percent of the county. It is about 32 percent Cincinnati soils, 19 percent Weisburg soils, 16 percent Bonnell soils, and 33 percent soils of minor extent (fig. 5).

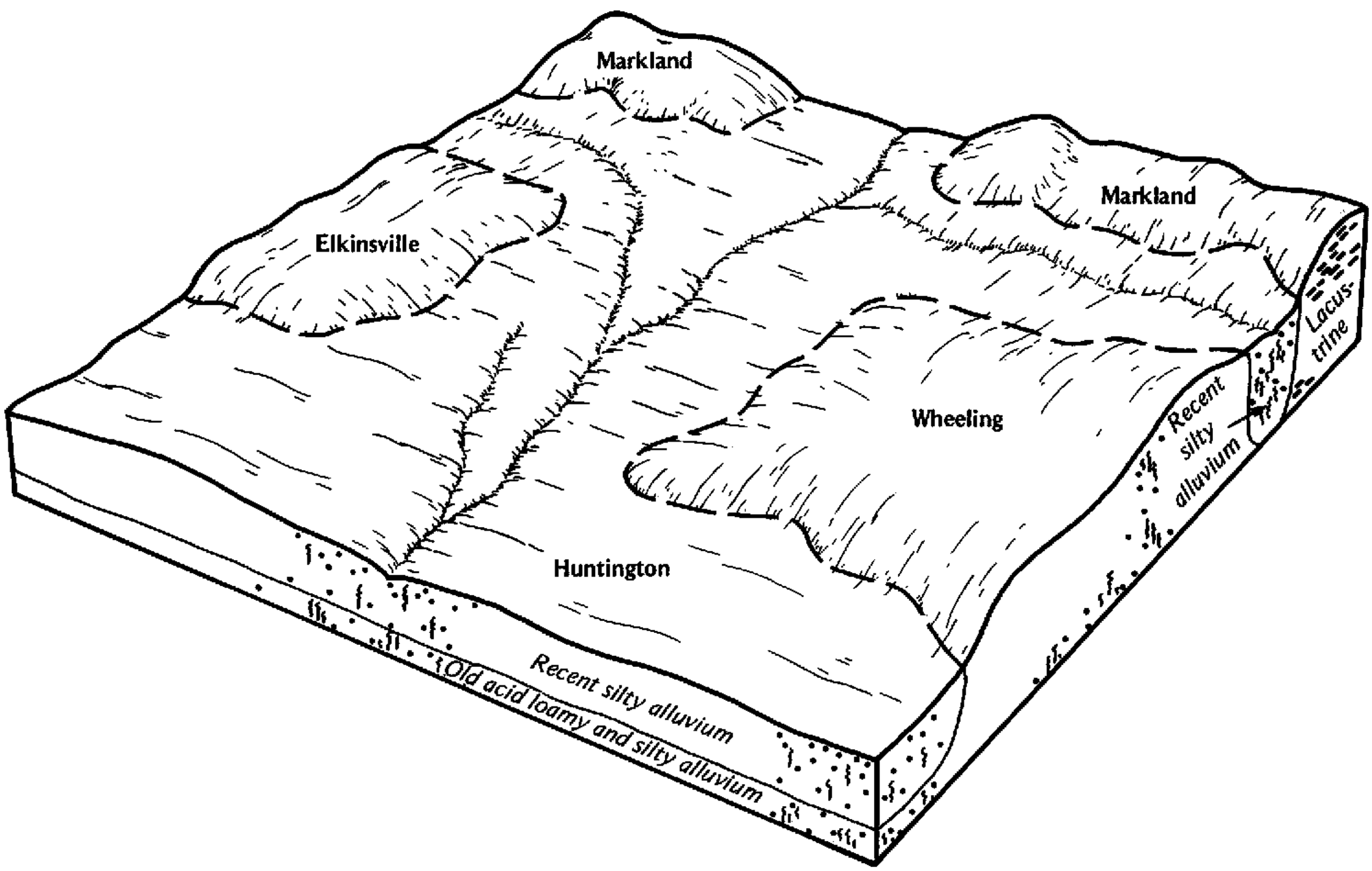

Figure 3.—General pattern of soils and parent material in the Huntington-Wheeling map unit.

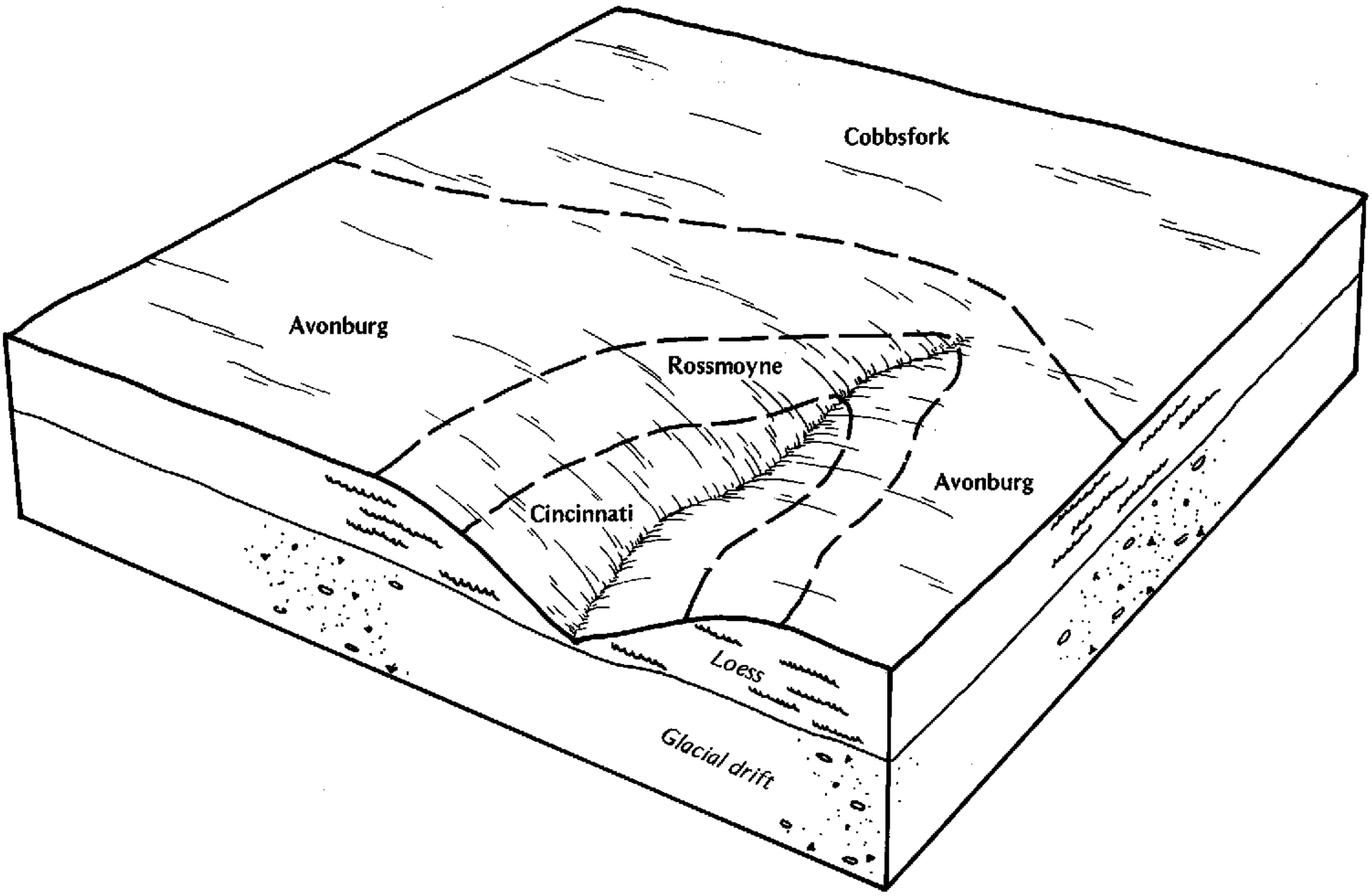

Figure 4.—General pattern of soils and parent material in the Avonburg-Cobbsfork map unit.

The gently sloping and moderately sloping Cincinnati soils are on summits, shoulder slopes, and back slopes. They have a slowly permeable fragipan. Typically, the surface layer is dark brown silt loam about 8 inches thick. The upper part of the subsoil is yellowish brown, mottled, friable and firm silt loam and silty clay loam. The next part is a fragipan of yellowish brown, mottled, very firm, brittle silt loam and clay loam. The lower part is strong brown, mottled, firm clay loam.

The gently sloping and moderately sloping Weisburg soils are on summits, shoulder slopes, and the upper back slopes. They have a slowly permeable fragipan. Typically, the surface layer is dark yellowish brown silt loam about 7 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, friable silt loam. The next part is a fragipan of strong brown and yellowish brown, mottled, very firm, brittle loam and clay loam. The lower part is yellowish brown, mottled, very firm clay.

The moderately sloping to moderately steep Bonnell soils are on summits, shoulder slopes, and back slopes. Typically, the surface layer is dark yellowish brown, friable silty clay loam about 7 inches thick. The subsoil is yellowish brown, firm silty clay loam in the upper part; strong brown and yellowish brown, firm clay loam in the next part; and yellowish brown, mottled, firm and very firm clay loam in the lower part. The substratum is yellowish brown clay loam.

Minor in this map unit are the Rossmoyne, Eden, and Switzerland soils. The deep, moderately well drained Rossmoyne soils are on summits, shoulder slopes, and the upper back slopes. They have grayish mottles in the upper part of the subsoil. The moderately deep, well drained Eden soils are on summits and back slopes. The deep, well drained Switzerland soils formed in a thin mantle of loess and in material weathered from limestone and calcareous shale. They are on summits, shoulder slopes, and back slopes.

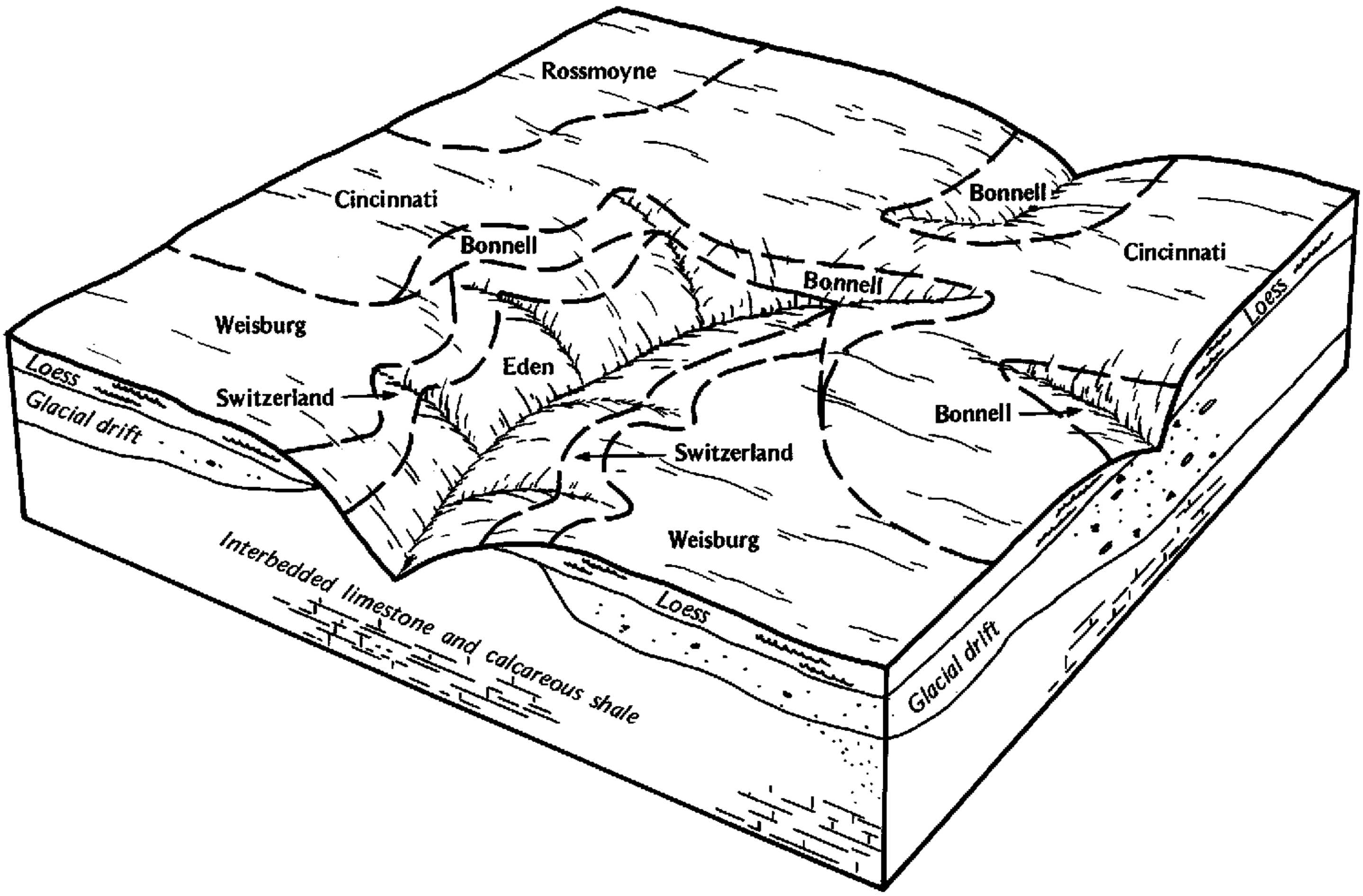

Figure 5.—General pattern of soils and parent material in the Cincinnati-Weisburg-Bonnell map unit.

This map unit is used mainly for cultivated crops, hay, and pasture. Some areas are wooded. The main crops are corn, soybeans, small grain, and tobacco.

This map unit is suited to cultivated crops in the more nearly level areas and to pasture and hay in the steeper areas. Erosion is the main hazard. It is such a severe hazard on the steeper slopes that growing cultivated crops is impractical. The suitability for urban uses is good in the more nearly level areas and in areas where public sewer systems can be installed. The suitability for the more intensive recreational uses is only fair because of slow permeability or slope.

4. Eden-Switzerland

Moderately deep and deep, gently sloping to very steep, well drained soils formed in a thin mantle of loess and in the underlying clayey material weathered from limestone and calcareous shale; on uplands

These soils are on highly dissected, unglaciated uplands. Areas are large and generally are in the southern part of the county.

This map unit makes up about 59 percent of the county. It is about 68 percent Eden soils, 17 percent Switzerland soils, and 15 percent soils of minor extent (fig. 6).

The moderately deep, strongly sloping to very steep Eden soils are on shoulder slopes and back slopes. Typically, the surface layer is dark brown flaggy silt loam about 5 inches thick. The subsoil is very firm. It is light olive brown silty clay and clay in the upper part and olive flaggy silty clay in the lower part. Slightly weathered, calcareous shale interbedded with fractured limestone is at a depth of about 26 inches.

The deep, gently sloping and moderately sloping Switzerland soils are on summits, shoulder slopes, and back slopes. Typically, the surface layer is dark brown silt loam about 10 inches thick. The upper part of the subsoil is strong brown, firm silty clay loam and very firm

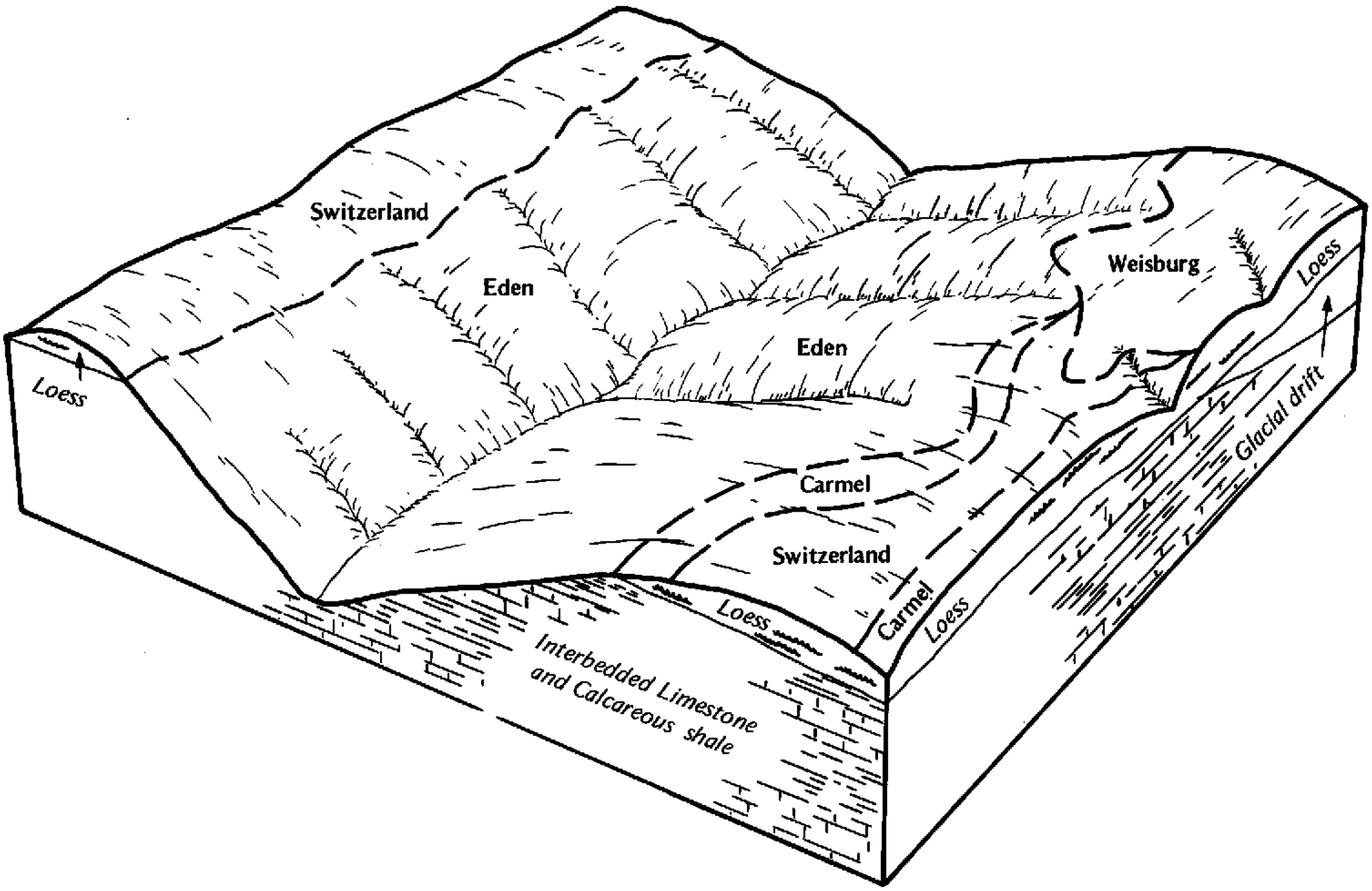

Figure 6.—General pattern of soils and parent material in the Eden-Switzerland map unit.

silty clay and clay. The lower part is light olive brown, very firm clay. The substratum is light olive brown very channery silty clay loam.

Minor in this map unit are the deep, well drained Weisburg and Carmel soils. Weisburg soils formed in a thin mantle of loess and in the underlying glacial till and clayey residuum. Carmel soils formed in a thin mantle of loess and in material weathered from limestone and calcareous shale.

This map unit is used mainly as pasture or woodland. Some small areas are used for hay or cultivated crops. Tobacco is the main crop in these small areas.

This map unit is suited to improved pasture. The slope is the main limitation, and erosion is the main hazard. Erosion is such a severe hazard on the steeper slopes that growing cultivated crops is impractical. The unit is suited to woodland. Productivity is moderately high. The slope, however, restricts the use of logging equipment, and erosion is a hazard along logging roads and skid trails. The unit is generally unsuited to urban uses because the slope is a severe limitation. The suitability for the more intensive recreational uses is poor because of the slope.

Broad Land Use Considerations

The general soil map can be helpful in planning land uses in broad areas. In Switzerland County these uses include urban development, cultivated crops, specialty crops, woodland, and recreational development.

Deciding which land should be used for urban development is an important issue in the county. Each year, some land is developed for urban uses along the Ohio River and in scattered small areas throughout the county. An estimated 700 acres is urban or built-up land. The general soil map is helpful in planning the general outline of urban areas. It cannot be used for the selection of sites for specific urban structures.

Areas where the soils are so unfavorable that urban development is not desirable or is nearly impossible are extensive in the county. Flooding is a severe hazard on the major soils in the Huntington-Wheeling map unit. The steeper soils in the Eden-Switzerland map unit are severely limited for urban development because of the slope. An extensive drainage system is needed on the wet soils in the Avonburg-Cobbsfork map unit. Many areas of the major soils in the Cincinnati-Weisburg-Bonnell map unit and the Switzerland soils in the Eden-Switzerland map unit can be developed for urban uses.

The Huntington-Wheeling map unit is well suited to most of the cultivated crops grown in the county. The Avonburg-Cobbsfork map unit is well suited to farming. The wetness of the major soils in this unit is a limitation, but a subsurface and surface drainage system has overcome this limitation in farmed areas. Some of the soils in the Cincinnati-Weisburg-Bonnell and Eden-Switzerland map units are well suited to farming, but erosion is a hazard. The steeper soils in these units are well suited to pasture if erosion is controlled.

The Huntington-Wheeling map unit is suited to vegetables and other specialty crops. Timely seeding and planting are needed on the Huntington soils because flooding is a hazard. The soils in this unit are well drained and warm up earlier in spring than wetter soils.

Most of the soils in the county are well suited or fairly well suited to woodland. Commercially valuable trees are less common on the wetter soils in the Avonburg-Cobbsfork map unit than on the soils in the other map units. Also, they generally do not grow so rapidly.

The Cincinnati-Weisburg-Bonnell map unit is well suited to parks and extensive recreational areas. Hardwood forests enhance the beauty of some areas in this unit. The Huntington soils in the Huntington-Wheeling map unit are severely limited as sites for intensive recreational uses because of flooding. These soils are well suited to the types of recreation that can be restricted to periods when flooding is unlikely. The Eden-Switzerland map unit generally is severely limited as a site for intensive recreational uses because of the slope. In many small areas, however, the soils are well suited to certain types of recreational development. Numerous small ravines are suitable sites for small lakes and ponds. Wooded areas are abundant throughout most of this map unit.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Cincinnati silt loam, 2 to 6 percent slopes, eroded, is a phase in the Cincinnati series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The names, descriptions, and delineations of the soils identified on the detailed soil maps of this county do not always agree or join fully with those of the soils identified on the maps of adjoining counties published at an earlier date. Some differences are the result of changes in concepts of soil series. Other differences result from variations in the extent of the soils. Others are the result of variations in the slope range allowed in the map units.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

AvA—Avonburg silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on tabular divides in the uplands. Individual areas are irregular in shape and are 20 to 200 acres in size. The dominant size is about 60 acres.

In a typical profile, the surface layer is about 9 inches of dark brown silt loam. The subsoil extends to a depth of 70 inches or more. In sequence downward, it is yellowish brown, mottled, friable silt loam; light brownish gray, mottled, firm, brittle silty clay loam; a fragipan of light brownish gray and gray, mottled, very firm, brittle silty clay loam; and yellowish brown, firm, brittle silty clay loam. Some small areas are gently sloping. In places the lower part of the subsoil is silt loam.

Included with this soil in mapping are a few small areas of the nearly level, poorly drained Cobbsfork soils near the center of the divides. Also included are the nearly level and gently sloping, moderately well drained Rossmoyne soils near slope breaks. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Avonburg soil. Permeability is very slow. Organic matter content is moderate in the surface layer. Surface runoff is slow in cultivated areas. A seasonal high water table is at a depth of 1 to 3 feet during a significant part of the year. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture, and a few are wooded.

If a suitable drainage system is established and maintained, this soil is well suited to corn, soybeans, and small grain. The wetness and the very slowly permeable fragipan are the major limitations. Excess water can be removed by shallow surface drains, tile drains, or both. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface improve or maintain tilth and the organic matter content.

This soil is well suited to some grasses and legumes for hay and pasture. These are alsike clover, ladino clover, white clover, red clover, tall fescue, and reed canarygrass. The soil is poorly suited to deep-rooted legumes, such as alfalfa, because the very slowly permeable fragipan restricts root penetration and the downward movement of water. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition, seedling mortality, and windthrow are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by cutting, spraying, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of wetness, low strength, and frost action, this soil is severely limited as a site for buildings and for local roads and streets. The seasonal high water table can be lowered and excess water removed by shallow surface drains, tile drains, or both. Dwellings should be constructed without basements. Strengthening foundations and footings and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the wetness and the very slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIw. The woodland ordination symbol is 4D.

AvB2—Avonburg silt loam, 2 to 4 percent slopes, eroded. This gently sloping, deep, somewhat poorly drained soil is on divides and the upper back slopes near the head of drainageways in the uplands. Individual areas are narrow and irregularly shaped and are 5 to 20 acres in size. The dominant size is about 10 acres.

In a typical profile, the surface layer is about 10 inches of dark brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil is about 55 inches thick. The upper part is yellowish brown, mottled, friable silt loam; the next part is light brownish gray, mottled, firm and very firm, brittle silty clay loam; and the lower part is strong brown, mottled, firm silty clay loam. The substratum to a depth of 80 inches is light brownish gray, mottled clay loam. Some small areas are nearly level.

Included with this soil in mapping are a few small areas of the moderately well drained Rossmoyne soils on summits and shoulder slopes. These soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Avonburg soil. Permeability is very slow in and below the fragipan. Organic matter content is moderate in the surface layer. Surface runoff is medium. The fragipan restricts root penetration and the downward movement of water. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily worked. A perched water table is at a depth of 1 to 3 feet during a significant part of the year.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture, and a few are wooded.

This soil is well suited to corn, soybeans, small grain, and tobacco. Erosion is the major hazard. The very slowly permeable fragipan and the wetness are the major limitations. If cultivated crops are grown, measures that control surface runoff and thus help to prevent excessive soil loss are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content. Subsurface tile is needed in seepy areas in some of the drainageways.

This soil is well suited to some grasses and legumes for hay and pasture. These are alsike clover, ladino clover, white clover, red clover, tall fescue, and reed canarygrass. The soil is poorly suited to deep-rooted legumes, such as alfalfa, because the very slowly permeable fragipan restricts root penetration and the downward movement of water. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition, seedling mortality, and windthrow are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Measures that control plant competition are especially important during the first few years after the seedlings are planted. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of wetness, low strength, and frost action, this soil is severely limited as a site for buildings and for local roads and streets. The seasonal high water table can be lowered and excess water removed by shallow surface drains, tile drains, or both. Dwellings should be constructed without basements. Strengthening foundations and footings and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the wetness and the very slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIe. The woodland ordination symbol is 4D.

BmC—Bloomfield loamy fine sand, 4 to 12 percent slopes. This moderately sloping, deep, well drained soil is on the narrow summits and back slopes of dunes on stream terraces. Individual areas are narrow and elongated and are 5 to 40 acres in size. The dominant size is about 10 acres.

In a typical profile, the surface layor is about 9 inches of dark brown loamy fine sand. The subsoil is about 40 inches of fine sandy loam that has bands of yellowish brown, loose fine sand and loamy fine sand. The upper part is strong brown and very friable, and the lower part is dark brown and friable. The substratum to a depth of 60 inches is yellowish brown, loose fine sand. In places the surface layer and subsoil have more silt and less sand. In a few small areas, they have more clay.

Included with this soil in mapping are small areas of Elkinsville and Wheeling soils on stream terraces. These soils are more clayey than the Bloomfield soil. They make up 5 to 10 percent of the unit.

Available water capacity is low in the Bloomfield soil. Permeability is moderately rapid or rapid. Organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is very friable or loose and can be easily worked. It is dominantly medium acid unless it is limed.

Most of the acreage of this soil is used for pasture and hay or for wildlife habitat. Some areas are used for cultivated crops.

This soil is fairly well suited to corn, small grain, and specialty crops, such as cantaloupes and watermelons. The low available water capacity is the main limitation, and erosion is the major hazard. During long dry periods, crop yields are reduced. Because of the low available water capacity, fall-seeded crops, such as winter wheat, are better suited than other crops. Conservation tillage helps to conserve moisture by leaving a protective cover of crop residue on the surface. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content. Crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems, grassed waterways, and grade stabilization structures help to control erosion and surface runoff.

This soil is well suited to some grasses and legumes for hay and pasture. These are red clover, Korean lespedeza, orchardgrass, and tall fescue. During long dry periods, the growth of pasture grasses is retarded. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The seedling mortality rate is the main management concern. It can be reduced by selection of proper planting stock and limited overstocking.

Because of the slope, this soil is moderately limited as a site for buildings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Cutting and filling are needed. Roads should be built on the contour if possible. The soil is severely limited as a site for septic tank absorption fields because of a poor filtering capacity, which can result in the pollution of ground water supplies. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly. Installing the absorption field in suitable fill material improves the filtering capacity.

The capability classification is IIIe. The woodland ordination symbol is 4S.

BoC2—Bonnell silty clay loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on narrow summits and shoulder slopes in the uplands. Individual areas are narrow and elongated and are 5 to 30 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 8 inches of dark brown silty clay loam mixed with a small amount of yellowish brown subsoil material. The subsoil extends to a depth of 80 inches. The upper part is strong brown silty clay loam; the next part is strong brown, very firm silty clay; and the lower part is strong brown, very firm clay loam. In some small areas the content of clay in the subsoil is less than 35 percent. In places limestone bedrock is within a depth of 60 inches.

Included with this soil in mapping are the gently sloping and moderately sloping Cincinnati soils on some of the broader summits. These soils have a fragipan. They make up 8 to 10 percent of the unit.

Available water capacity is high in the Bonnell soil. Permeability is slow. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some of the acreage is used for cultivated crops, is idle land, or is used as woodland.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The equipment limitation and plant competition are the main management concerns. The use of equipment is limited when the soil is wet and sticky. Some replanting may be needed, but seedlings usually survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Measures that control plant competition are especially important during the first few years after the seedlings are planted.

Because of the shrink-swell potential, low strength, and the slow permeability, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible. Installing septic tank absorption fields in suitable fill material improves the capacity of the fields to absorb effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

BoE2—Bonnell silty clay loam, 15 to 25 percent slopes, eroded. This strongly sloping and moderately steep, deep, well drained soil is on back slopes in the uplands. Individual areas are narrow and irregularly shaped and range from 10 to 60 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is about 7 inches of dark yellowish brown silty clay loam mixed with a small amount of yellowish brown silt loam. The subsoil extends to a depth of 65 inches. The upper part is yellowish brown, firm silty clay loam; the next part is strong brown and yellowish brown, firm clay loam; and the lower part is yellowish brown, mottled, firm and very firm clay loam. The substratum to a depth of 80 inches is yellowish brown, firm clay loam. In some places the surface layer is loam. In other places the content of clay is less than 35 percent throughout the subsoil. In some areas limestone bedrock is within a depth of 60 inches.

Included with this soil in mapping are a few small areas of the moderately sloping, well drained Cincinnati soils on the upper part of shoulder slopes. These soils have a fragipan. They make up 8 to 10 percent of the unit.

Available water capacity is high in the Bonnell soil. Permeability is slow. Organic matter content is moderate in the surface layer. Surface runoff is very rapid. The surface layer is dominantly medium acid.

Most areas are wooded or pastured or support brush. Some are used for hay. Because of the slope and a severe hazard of erosion, this soil is generally unsuited to cultivated crops.

In areas where the slope is less than 20 percent, this soil is fairly well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees (fig. 7). The equipment limitation, the erosion hazard, and plant competition are the main management concerns. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on these slopes. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, culverts, and drop structures.

Because of the shrink-swell potential, the slope, low strength, and the slow permeability, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is VIe. The woodland ordination symbol is 4R.

CaC2—Carmel silty clay loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on summits and shoulder slopes in the uplands. Individual areas are narrow and elongated and are 5 to 35 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 7 inches of dark brown silty clay loam mixed with a small amount of strong brown silty clay loam. The subsoil is very firm clay about 27 inches thick. The upper part is strong brown, and the lower part is yellowish brown and mottled. The substratum is light olive brown, mottled very channery clay about 11 inches thick. Interbedded, calcareous shale and limestone bedrock is at a depth of about 45 inches. In places the depth to bedrock is 20 to 40 inches. In some areas the soil is underlain by glacial till.

Included with this soil in mapping are the gently sloping and moderately sloping, well drained Switzerland soils on some of the broader summits. These soils formed in 20 to 36 inches of loess and in bedrock residuum. They make up 8 to 10 percent of the unit.

Available water capacity is low in the Carmel soil. Permeability is very slow. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some of the acreage is used for cultivated crops, wildlife habitat, or woodland.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality, windthrow, and plant competition are the main management concerns. Some replanting may be needed, but seedlings usually survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the shrink-swell potential, low strength, and the very slow permeability, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible. Installing septic tank absorption fields in suitable fill material improves the capacity of the fields to absorb effluent.

The land capability classification is IIIe. The woodland ordination symbol is 5C.

CaC3—Carmel silty clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping,

Figure 7.—Mixed hardwoods on Bonnell silty clay loam, 15 to 25 percent slopes, eroded.

deep, well drained soil is on summits and shoulder slopes in the uplands. Severe erosion has removed most of the original surface soil. Individual areas are narrow and elongated and range from 5 to 25 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 6 inches of yellowish brown silty clay loam mixed with a small amount of dark yellowish brown silty clay loam. The subsoil is about 40 inches thick. The upper part is strong brown, firm silty clay loam; the next part is strong brown and yellowish brown, very firm silty clay; and the lower part is yellowish brown, very firm clay. Calcareous, clayey shale interbedded with thin layers of limestone is at a depth of about 46 inches. In places the depth to bedrock is 20 to 40 inches. In some areas the soil is underlain by glacial till.

Included with this soil in mapping are the gently sloping and moderately sloping, well drained Switzerland soils on the higher summits. These soils formed in 20 to 36 inches of loess and in bedrock residuum. They make up 8 to 10 percent of the unit.

Available water capacity is low in the Carmel soil. Permeability is very slow. Organic matter content is low in the surface layer. Surface runoff is rapid. The surface layer is firm and becomes cloddy and hard to work if tilled when it is too wet. It generally is strongly acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some of the acreage is used for cultivated crops, wildlife habitat, or woodland.

This soil is poorly suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is fairly well suited to grasses and legumes for hay and is well suited to pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the equipment limitation, plant competition, and windthrow are management concerns. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Selection of proper planting stock and limited overstocking reduce the seedling mortality rate. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. The use of equipment is limited when the soil is wet and sticky.

Because of the shrink-swell potential, low strength, and the very slow permeability, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible. Installing septic tank absorption fields in suitable fill material improves the capacity of the fields to absorb effluent.

The land capability classification is IVe. The woodland ordination symbol is 4C.

Ch—Chagrin silt loam, occasionally flooded. This nearly level, deep, well drained soil is on bottom land. It is occasionally flooded for brief periods, usually in winter and early in spring. Individual areas are narrow and extend for long distances along the streams. They are 5 to 60 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is dark brown and friable. The upper part is silt loam, and the lower part is loam. The substratum to a depth of 60 inches is dark brown, friable loam and dark yellowish brown, firm channery coarse sandy loam. In places the surface layer and subsoil have more silt and less sand and clay. In some areas the soil shows little or no evidence of subsoil development. In other areas free carbonates are throughout the subsoil.

Included with this soil in mapping are small areas of Dearborn soils on bottom land. These soils are more flaggy than the Chagrin soil. Also included, on the lower part of foot slopes, are small areas of the moderately deep Eden and deep Pate soils, which are more clayey than the Chagrin soil. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Chagrin soil. Permeability is moderate. A seasonal high water table is at a depth of 4 to 6 feet. Organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be easily worked. It is neutral to medium acid.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture.

This soil is well suited to corn and soybeans. It is not suited to small grain because severe crop damage can occur during periods of flooding. Management of crop residue, cover crops, and green manure crops improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Alfalfa can be severely damaged, however, during periods of flooding. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is severe. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the flooding, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is IIw. The woodland ordination symbol is 5A.

CnB2—Cincinnati silt loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, well drained soil is on summits and shoulder slopes in the uplands. Individual areas are narrow and irregularly shaped and are 5 to 30 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 8 inches of dark brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil extends to a depth of 80 inches or more. The upper part is yellowish brown, mottled, friable and firm silt loam and yellowish brown, firm silty clay loam; the next part is a fragipan of yellowish brown, mottled, very firm, brittle silt loam and clay loam; and the lower part is strong brown, mottled, firm clay loam. In places the lower part of the subsoil formed in clayey residuum. In some small areas the soil is moderately well drained.

Included with this soil in mapping are a few small areas of the moderately sloping, well drained Bonnell soils. These soils are more clayey than the Cincinnati soil. They make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Cincinnati soil. Permeability is moderate above the fragipan and slow in and below the fragipan. A seasonal high water table is at a depth of 2.5 to 4.0 feet. Organic matter content is moderate in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops. A few small areas are used as woodland.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

This soil is suitable as a site for dwellings without basements. It is moderately limited as a site for dwellings with basements because of the wetness. Subsurface drains help to lower the water table. The soil is severely limited as a site for local roads and streets because of low strength and frost action. The base material for the roads and streets should be strengthened or replaced with better suited material. Providing adequate side ditches and culverts helps to prevent the damage caused by frost action.

Because of the wetness and the slow permeability in the fragipan, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIe. The woodland ordination symbol is 4A.

CnC2—Cincinnati silt loam, 6 to 12 percent slopes, eroded. This deep, moderately sloping, well drained soil is on summits, shoulder slopes, and back slopes in the uplands. Individual areas are narrow and elongated and are 20 to 80 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 8 inches of dark brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil is more than 60 inches thick. The upper part is yellowish brown, friable silt loam and silty clay loam; the next part is a fragipan of yellowish brown, mottled, very firm, brittle silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. In some areas the soil formed in a thin layer of loess and in the underlying glacial drift and clayey residuum.

Included with this soil in mapping are small areas of the well drained, strongly sloping Bonnell and Switzerland soils on back slopes. These soils are more clayey than the Cincinnati soil. They do not have a fragipan. Also included are small areas of the well drained Chagrin soils, which formed in alluvium along drainageways. Included soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Cincinnati soil. Permeability is moderate above the fragipan and slow in and below the fragipan. A seasonal high water table is at a depth of 2.5 to 4.0 feet. Organic matter content is moderate in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops. A few small areas are used as woodland.

This soil is fairly well suited to corn, soybeans, and small grain. The hazard of erosion is severe in cultivated areas. Measures that control erosion and surface runoff are needed. Examples are crop rotations, that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay (fig. 8) and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, pasture rotation, measures that maintain fertility, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the slope and the wetness, this soil is moderately limited as a site for buildings. It is severely limited as a site for local roads and streets because of low strength and frost action. Buildings should be designed so that they conform to the natural slope of the land. Subsurface drains help to lower the water table. The base material for local roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in

Figure 8.—Alfalfa hay on Cincinnati silt loam, 6 to 12 percent slopes, eroded.

suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

CnC3—Cincinnati silt loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, deep, well drained soil is on summits, shoulder slopes, and back slopes in the uplands. Individual areas are narrow and elongated and are 15 to 40 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is about 8 inches of yellowish brown silt loam mixed with a small amount of dark yellowish brown silt loam. The subsoil is about 62 inches thick. The upper part is yellowish brown and strong brown, friable and firm silty clay loam; the next part is a fragipan of strong brown, mottled, very firm, brittle clay loam; and the lower part is yellowish brown, very firm silty clay. The substratum to a depth of more than 80 inches is yellowish brown, calcareous clay till. In some small areas the soil is moderately well drained.

Included with this soil in mapping are small areas of the well drained, strongly sloping Bonnell soils on back slopes and small areas of Weisburg soils on back slopes and summits. Bonnell soils are more clayey than the Cincinnati soil. They do not have a fragipan. Weisburg soils have clayey residuum at a depth of 48 to 72 inches. Also included are small areas of the well drained Chagrin soils, which formed in alluvium along drainageways. Included soils make up 8 to 10 percent of the unit.

Available water capacity is low in the Cincinnati soil. Permeability is moderate above the fragipan and slow in and below the fragipan. A seasonal high water table is at a depth of 2.5 to 4.0 feet. Organic matter content is low in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops.

This soil is poorly suited to corn, soybeans, and small grain. The hazard of erosion is severe in cultivated areas. Measures that control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is poorly suited to grasses and legumes for hay and is well suited to pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the slope and the wetness, this soil is moderately limited as a site for buildings. It is severely limited as a site for local roads and streets because of low strength and frost action. Buildings should be designed so that they conform to the natural slope of the land. Subsurface drains help to lower the water table. The base material for roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IVe. The woodland ordination symbol is 4A.

Co—Cobbsfork silt loam. This nearly level, deep, poorly drained soil is on tabular divides in the uplands. It is subject to ponding. Individual areas are broad and irregularly shaped and are 40 to 1,000 acres in size. The dominant size is about 200 acres.

In a typical profile, the surface layer is about 6 inches of grayish brown, mottled silt loam. The subsurface layer is about 5 inches of gray, mottled silt loam. The subsoil to a depth of 80 inches is mottled silt loam. The upper part is light brownish gray and friable; the next part is gray, firm, and brittle; and the lower part is gray, very firm, and brittle. In places the soil has a fragipan.

Included with this soil in mapping are the somewhat poorly drained Avonburg soils near the edges of the tabular divides. These soils make up 8 to 10 percent of the unit.

Available water capacity is very high in the Cobbsfork soil. Permeability is very slow. Organic matter content is low in the surface layer. Surface runoff is very slow in cultivated areas. A seasonal high water table is near or above the surface during a significant part of the year. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture or are wooded.

If a suitable drainage system is established and maintained, this soil is fairly well suited to corn, soybeans, and small grain. Excess water can be removed by shallow surface drains, tile drains, or both. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to maintain tilth and the organic matter content.

This soil is well suited to some grasses and legumes for hay and pasture. These are alsike clover, ladino clover, white clover, red clover, tall fescue, and reed canarygrass. The soil is poorly suited to deep-rooted legumes, such as alfalfa, because of prolonged periods of excessive wetness. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The equipment limitation, seedling mortality, windthrow, and plant competition are management concerns. Prolonged seasonal wetness hinders the use of harvesting, logging, and planting equipment. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the ponding, the potential for frost action, and the very slow permeability, this soil is generally unsuitable for building site development and sanitary facilities.

The land capability classification is IIIw. The woodland ordination symbol is 6W.

Dn—Dearborn loam, frequently flooded. This nearly level, deep, well drained soil is on toe slopes, fans, and bottom land adjacent to rapidly flowing streams that drain steep soils in the uplands. It is frequently flooded for very brief periods. Individual areas are narrow and elongated and are 5 to 80 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 10 inches of dark brown loam. The subsoil is dark brown, friable channery loam about 5 inches thick. The substratum to a depth of 60 inches is dark brown extremely channery coarse sandy loam and extremely channery loam. In some areas the surface layer is silt loam, silty clay loam, or channery silt loam.

Included with this soil in mapping are small areas of Chagrin soils on the slightly higher parts of the bottom land and the moderately deep Eden and deep Pate soils on the higher back slopes. The content of coarse fragments throughout the Chagrin soils is lower than that in the Dearborn soil. Eden and Pate soils are more clayey than the Dearborn soil. They formed in limestone and shale residuum. Also included, on bottom land near the head of streams and on the higher foot slopes, are the well drained Woolper soils, which formed in colluvium and are more clayey than the Dearborn soil. Included soils make up 10 to 12 percent of the unit.

Available water capacity is low in the Dearborn soil. Permeability is moderate in the upper part of the soil and moderately rapid in the lower part. Organic matter content is moderate in the surface layer, and natural fertility is high. Surface runoff is slow in cultivated areas. The surface layer is friable and can be easily worked. It is mildly alkaline.

Most areas of this soil are used for hay and pasture. Many are used for cultivated crops. Some of the acreage is wildlife habitat. A few areas are used as woodland.

This soil is fairly well suited to corn and tobacco. It is generally unsuited to small grain, however, because of the crop damage caused by floodwater. The main hazard is the frequent flooding, and the main limitation is droughtiness in summer. Conservation tillage conserves moisture by leaving a protective cover of crop residue on the surface.

This soil is well suited to some grasses and legumes for hay or pasture. These are alfalfa, bromegrass, orchardgrass, and bluegrass. The main limitation is droughtiness in summer. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted. The use of planting or logging equipment is limited during wet periods.

Because of the flooding, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is IIIs. The woodland ordination symbol is 6A.

Dr—Dearborn channery silt loam, frequently flooded. This nearly level, deep, well drained soil is on toe slopes, fans and bottom land adjacent to rapidly flowing streams that drain steep and very steep soils in the uplands. It is frequently flooded for very brief periods. Scattered fragments of limestone are on the surface. Individual areas are narrow and elongated and are 5 to 80 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 5 inches of dark brown channery silt loam. The subsoil is about 14 inches thick. It is dark brown. The upper part is friable channery loam, and the lower part is firm channery clay loam. The substratum to a depth of 60 inches is brown, firm very channery clay loam. In some areas the surface layer is loam, silty clay loam, channery loam, gravelly loam, or flaggy loam. In other areas the soil is deeper to the substratum and has more silt and less sand throughout the surface layer and subsoil.

Included with this soil in mapping are the well drained, moderately deep Eden and well drained, deep Pate soils on the higher back slopes and the well drained Woolper soils on the higher toe slopes and fans and in areas near the head of drainageways. Eden and Pate soils formed in limestone and shale residuum. Woolper soils formed in colluvium or alluvium derived from soils that formed in limestone and shale residuum. Also included, on the slightly higher parts of the bottom land, are small areas of the well drained Chargin soils, which formed in alluvium and have a lower content of coarse fragments than the Dearborn soil. Included soils make up 10 to 12 percent of the unit.

Available water capacity is low in the Dearborn soil. Permeability is moderate in the upper part of the soil and moderately rapid in the lower part. Organic matter content is moderate in the surface layer, and natural fertility is high. Surface runoff is slow. The surface layer is friable, but it is difficult to work because it is channery. It is mildly alkaline.

Most areas of this soil are used for hay and pasture. Much of the acreage is wildlife habitat. A few areas are used as woodland.

This soil is fairly well suited to corn and tobacco. It is generally unsuited to small grain, however, because of the crop damage caused by floodwater. The main hazard is the frequent flooding, and the main limitations are droughtiness in summer and the channery surface layer. Conservation tillage conserves moisture by leaving a protective cover of crop residue on the surface.

This soil is well suited to some grasses and legumes for hay and pasture. These are alfalfa, bromegrass, orchardgrass, and bluegrass. The main limitations are droughtiness in summer and the channery surface layer. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted. The growth of black walnut and other species that require a soil free of coarse fragments is somewhat restricted because of a limited rooting depth. The use of planting or logging equipment is limited during wet periods.

Because of the flooding, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is IIIs. The woodland ordination symbol is 6A.

EdF2—Eden flaggy silt loam, 25 to 50 percent slopes, eroded. This steep and very steep, moderately deep, well drained soil is on back slopes in the uplands. Individual areas are elongated and irregularly shaped and are 50 to several thousand acres in size. The dominant size is about 500 acres.

In a typical profile, the surface layer is about 5 inches of dark brown flaggy silt loam. The subsoil is about 21 inches thick. The upper part is light olive brown, very firm silty clay and clay, and the lower part is olive, very firm flaggy silty clay. Slightly weathered, calcareous shale interbedded with fractured limestone is at a depth of about 26 inches. In places the depth to bedrock is more than 40 inches. In some areas the soil is underlain by hard limestone bedrock.

Included with this soil in mapping are the deep, well drained Carmel and Switzerland soils on the higher summits, shoulder slopes, and back slopes. Also included are small areas of the well drained Dearborn soils, which formed in alluvium on toe slopes and bottom land. Included soils make up 8 to 10 percent of the unit.

Available water capacity is very low in the Eden soil. Permeability is slow. Organic matter content is moderate in the surface layer, and natural fertility is high. Surface runoff is very rapid. The depth of the root zone is 20 to 40 inches. Reaction in the surface layer is dominantly neutral.

Most areas are used as woodland. Some are used as permanent pasture. A few are used as wildlife habitat. This soil is generally unsuited to cultivated crops because of the slope and a severe hazard of erosion.

This soil is poorly suited to most grasses and legumes for permanent pasture, but it is suited to tall fescue and orchardgrass. It is generally unsuited to hay because of the slope and the flaggy surface layer. Machinery that can be operated on steep or very steep slopes should be used during seedbed preparation. A permanent stand of grasses and legumes helps to control surface runoff and erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods are needed.

This soil is fairly well suited to trees. The erosion hazard, the equipment limitation, seedling mortality, windthrow, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, culverts, and drop structures.

Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on these slopes. Disturbing the ground cover as little as possible helps to prevent excessive soil loss. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the depth to bedrock, the slope, and low strength, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is VIIe. The woodland ordination symbol is 4R.

EeE2—Eden silty clay loam, 15 to 50 percent slopes, eroded. This strongly sloping to very steep, moderately deep, well drained soil is on summits and the upper part of back slopes in the uplands. Individual areas are long and narrow or are irregularly shaped. They are 10 to several hundred acres in size.

In a typical profile, the surface layer is about 6 inches of dark grayish brown silty clay loam mixed with a small amount of yellowish brown silty clay. The subsoil is about 20 inches thick. The upper part is yellowish brown, very firm silty clay, and the lower part is dark brown, very firm flaggy silty clay. Slightly weathered, calcareous shale interbedded with fractured limestone is at a depth of about 26 inches. In some places the surface layer is silt loam, flaggy silt loam, or flaggy silty clay loam. In other places the soil is underlain by hard limestone bedrock.

Included with this soil in mapping are small areas of the deep Dearborn soils, which formed in alluvium along drainageways. Also included are the deep, well drained Switzerland soils on the higher parts of summits, shoulder slopes, and back slopes. Included soils make up 8 to 10 percent of the unit.

Available water capacity is low in the Eden soil. Permeability is slow. The depth of the root zone is 20 to 40 inches. Organic matter content is moderate in the surface layer. Surface runoff is very rapid. Reaction in the surface layer is dominantly neutral.

Most areas are wooded or pastured or support brush. Some are used for hay. This soil is generally unsuited to cultivated crops because of the slope and a severe hazard of erosion.

This soil is fairly well suited to pasture grasses, such as tall fescue and orchardgrass (fig. 9). Hay can be grown in areas where the slope is less than 20 percent. A cover of pasture grasses is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The erosion hazard, the equipment limitation, seedling mortality, windthrow, and plant competition are management concerns. Some replanting may be needed, but seedlings usually survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Disturbing the ground cover as little as possible helps to prevent excessive soil loss. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on these slopes. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, culverts, and drop structures. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the depth to bedrock, the slope, and low strength, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is VIe. The woodland ordination symbol is 4R.

EkA—Elkinsville silt loam, rarely flooded, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on broad terraces along the Ohio River. It is in areas between steep and very steep Eden soils on upland back slopes and the lower lying Huntington soils on bottom land. Individual areas are irregular in shape and are 30 to 80 acres in size. The dominant size is about 50 acres.

In a typical profile, the surface layer is about 10 inches of dark brown silt loam. The subsoil is strong brown, dark brown, and dark yellowish brown, friable silt loam about 48 inches thick. The substratum to a depth of 80 inches is yellowish brown silt loam. In some small areas the surface layer is loam, fine sandy loam, or loamy fine sand. In places the subsoil is slightly acid. In a few small areas, it has less silt and more sand.

Included with this soil in mapping are small areas of the well drained Huntington soils on bottom land along the Ohio River. These soils are less acid than the Elkinsville soil. They formed in recent alluvium. Also included, near the center of the stream terraces, are small areas of the moderately well drained Pekin soils, which have a fragipan. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Elkinsville soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Figure 9.—A fescue pasture in an area of Eden silty clay loam, 15 to 50 percent slopes, eroded.

Most areas of this soil are used for cultivated crops. Some are used for pasture and hay or for urban development.

This soil is well suited to corn, soybeans, and small grain. No serious limitations or hazards affect cropping. A system of conservation tillage that leaves protective amounts of crop residue on the surface, cover crops, and green manure crops improve or maintain tilth and the organic matter content. Subsurface tile is needed in seepy areas in some of the drainageways and swales.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by adequate site preparation or by spraying, cutting, or girdling.

Because of the rare flooding, frost action, and low strength, this soil is severely limited as a site for buildings and for local roads and streets. It is moderately limited as a site for septic tank absorption fields because of the rare flooding. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing roads and buildings on raised, well compacted fill material and providing adequate roadside ditches and culverts help to prevent the damage caused by flooding and frost action.

The land capability classification is I. The woodland ordination symbol is 5A.

EkB—Elkinsville silt loam, rarely flooded, 2 to 8 percent slopes. This gently sloping, deep, well drained soil is on terraces along the Ohio River. It is in areas between steep and very steep Eden soils on upland back slopes and the lower lying Huntington soils on bottom land. Individual areas are irregularly shaped and are 5 to 100 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 9 inches of dark brown silt loam. The subsoil is about 38 inches thick. It is dark yellowish brown, friable silt loam in the upper part; yellowish brown, friable silt loam in the next part; and yellowish brown, firm silty clay loam in the lower part. The substratum to a depth of 60 inches is yellowish brown silt loam. In some small areas the surface layer is loam. In others the soil is eroded. In some small areas the surface layer and subsoil have more sand and less silt.

Included with this soil in mapping are small areas of the well drained Huntington soils on bottom land along the Ohio River. These soils are less acid than the Elkinsville soil. They formed in recent alluvium. Also included, near the center of the stream terraces, are small areas of the moderately well drained Pekin soils, which have a fragipan. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Elkinsville soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is medium in cultivated areas. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses and legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the rare flooding, frost action, and low strength, this soil is severely limited as a site for buildings and for local roads and streets. It is moderately limited as a site for septic tank absorption fields because of the rare flooding. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing roads and buildings on raised, well compacted fill material and providing adequate roadside ditches and culverts help to prevent the damage caused by flooding and frost action.

The land capability classification is IIe. The woodland ordination symbol is 5A.

Hu—Huntington silt loam, occasionally flooded. This nearly level, deep, well drained soil is on bottom land along the Ohio River and its larger tributaries. The soil is occasionally flooded in winter and early in spring. The areas along the Ohio River are at the highest level of the bottom land, adjacent to terraces or uplands. Individual areas are narrow and elongated and are 30 to 300 acres in size. The dominant size is about 100 acres.

In a typical profile, the surface layer is about 8 inches of dark brown silt loam. The subsurface layer is about 8 inches of dark brown silty clay loam. The subsoil extends to a depth of 80 inches or more. It is dark brown and dark yellowish brown, firm silty clay loam in the upper part and dark yellowish brown, friable silt loam in the lower part. Some areas have received moderately dark colored overwash. In some small areas the surface soil and subsoil have more sand. In other small areas the lower part of the subsoil has a high content of coarse fragments.

Included with this soil in mapping are small areas of the well drained Elkinsville soils on stream terraces and the well drained Pate soils on the lower back slopes. Elkinsville soils are more acid than the Huntington soil. They formed in loess and stratified, silty or loamy material. Pate soils are more clayey than the Huntington soil. They formed in material weathered from interbedded limestone and calcareous shale. Also included are small areas of the well drained Chagrin soils and the somewhat poorly drained Newark soils. Chagrin soils formed in loamy alluvium near stream channels. Newark soils are in old sloughs and depressions on bottom land. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Huntington soil. Permeability is moderate. Organic matter content is moderate in the surface layer, and natural fertility is high. Surface runoff is slow. The surface layer is friable and can be easily worked. It is slightly acid to mildly alkaline.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture.

This soil is well suited to corn and soybeans. It is not suited to small grain because severe crop damage can occur during prolonged periods of flooding. Crop residue management, cover crops, and green manure crops improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Alfalfa can be severely damaged, however, during periods of prolonged flooding. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedlings can survive and grow well if plant competition is controlled by adequate site preparation or by spraying, cutting, or girdling.

Because of the flooding, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is IIw. The woodland ordination symbol is 7A.

MaB2—Markland silt loam, 1 to 6 percent slopes, eroded. This gently sloping, deep, well drained or moderately well drained soil is in narrow, convex areas and on slope breaks on lacustrine terraces. Individual areas are irregularly shaped and are 5 to 60 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 7 inches of dark brown silt loam mixed with a small amount of yellowish brown silty clay loam. The subsoil is yellowish brown, very firm silty clay about 30 inches thick. The substratum to a depth of 60 inches also is yellowish brown, very firm silty clay. In some areas the depth to carbonates is more than 44 inches. In places the layer of loess is more than 15 inches thick.

Included with this soil in mapping are small areas of well drained soils that formed in alluvium on bottom land. These soils make up 5 to 10 percent of the unit.

Available water capacity is moderate in the Markland soil. Permeability is slow. A seasonal high water table is at a depth of 3 to 6 feet. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It is dominantly medium acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops, and a few are used for urban development.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control surface runoff and erosion are needed. Examples are crop rotations that include grasses and legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is fairly well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, windthrow, and plant competition are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the shrink-swell potential, low strength, the slow permeability, and the wetness, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Installing septic tank absorption fields in suitable fill material improves the capacity of the fields to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

MaC2—Markland silt loam, 8 to 15 percent slopes, eroded. This moderately sloping, deep, well drained or moderately well drained soil is on the sides of lacustrine terraces. Individual areas are narrow and irregularly shaped and are 10 to 40 acres in size. The dominant size is about 30 acres.

In a typical profile, the surface layer is about 8 inches of dark grayish brown silt loam mixed with a small amount of dark brown silty clay loam. The subsoil is about 30 inches thick. The upper part is dark brown, very firm silty clay loam, and the lower part is dark yellowish brown and yellowish brown, very firm silty clay. The substratum to a depth of 60 inches is yellowish brown, very firm silty clay. In some small areas the depth to carbonates is less than 20 or more than 44 inches.

Included with this soil in mapping are small areas of the well drained Huntington soils on bottom land. These soils are less clayey than the Markland soil. They formed in alluvium. Also included are small areas of Markland soils on escarpments. Included soils make up 5 to 10 percent of the unit.

Available water capacity is moderate in the Markland soil. Permeability is slow. A seasonal high water table is at a depth of 3 to 6 feet. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It is dominantly medium acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops or for wildlife habitat.

This soil is poorly suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is fairly well suited to grasses and legumes for hay and is well suited to pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality, windthrow, and plant competition are the main management concerns. Selection of proper planting stock and limited overstocking reduce the seedling mortality rate. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling.

Because of the shrink-swell potential, the slope, low strength, the slow permeability, and the wetness, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with a better suited material. Cutting and filling are needed. The roads should be built on the contour if possible. Installing septic tank absorption fields in suitable fill material improves the capacity of the fields to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IVe. The woodland ordination symbol is 4C.

Ne—Newark silt loam, occasionally flooded. This nearly level, deep, somewhat poorly drained soil is in sloughs and depressions on bottom land. It is occasionally flooded for brief periods. Individual areas are narrow and elongated and are 5 to 30 acres in size. The dominant size is about 10 acres.

In a typical profile, the surface layer is about 7 inches of dark brown silt loam. The subsurface layer also is dark brown silt loam. It is about 8 inches thick. The subsoil is about 20 inches thick. It is grayish brown. The upper part is friable silt loam, and the lower part is firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown and dark grayish brown, firm silty clay loam. In some small areas the surface layer is dark. In some areas the upper part of the subsoil is grayer. In places the surface soil and subsoil have less clay and more sand.

Included with this soil in mapping are small areas of the well drained Huntington soils on the slightly higher parts of the bottom land. These soils make up 5 to 10 percent of the unit.

Available water capacity is high in the Newark soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is slow. A seasonal water table is at a depth of 0.5 to 1.5 feet. The surface layer is friable and can be easily worked. It is neutral in reaction.

Most areas of this soil are used for hay or pasture. Some are used for cultivated crops.

If a suitable drainage system is established and maintained, this soil is well suited to corn and soybeans. It is not suited to small grain because severe crop damage can occur during periods of flooding. Tile and shallow surface drains help to remove excess surface water. A system of conservation tillage that leaves protective amounts of crop residue on the surface, cover crops, and green manure crops help to maintain or improve the organic matter content and tilth.

This soil is well suited to some grasses and legumes for hay and pasture. These are alsike clover, ladino clover, white clover, red clover, tall fescue, and reed canarygrass. Alfalfa can be severely damaged during periods of flooding. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The equipment limitation, plant competition, and windthrow are the main management concerns. Equipment should be used only when the soil is relatively dry or frozen. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the flooding and the wetness, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is IIw. The woodland ordination symbol is 5W.

PaE2—Pate silt loam, 15 to 25 percent slopes, eroded. This strongly sloping and moderately steep, deep, well drained soil is on foot slopes in the uplands. In some areas scattered coarse fragments of limestone are on the surface, especially on the upper part of the slopes. Individual areas are narrow and elongated and are 40 to 200 acres in size.

In a typical profile, the surface layer is about 5 inches of dark brown silt loam mixed with a small amount of dark yellowish brown silty clay loam. The subsoil is about 50 inches thick. The upper part is yellowish brown and dark yellowish brown, very firm silty clay, and the lower part is light olive brown, very firm flaggy clay. Interbedded limestone and shale bedrock is at a depth of about 55 inches. In some areas the surface layer is flaggy silt loam or flaggy silty clay loam. In some small areas the upper 10 to 30 inches is dark brown or dark yellowish brown silt loam. In places the soil is moderately deep.

Included with this soil in mapping are small areas of the well drained Dearborn and Huntington soils, which formed in alluvium on bottom land. These soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Pate soil. Permeability is very slow. Organic matter content is moderate in the surface layer. Surface runoff is very rapid. Reaction is dominantly neutral in the surface layer.

Most areas are used for hay and pasture. Much of the acreage is woodland or abandoned cropland (fig. 10). This soil is generally unsuited to row crops because of the slope and a severe hazard of erosion. Small grain is occasionally grown to reestablish stands of grasses and legumes.

Because of the slope and the hazard of erosion, this soil is poorly suited to grasses and legumes for hay and permanent pasture. A permanent stand of grasses and legumes, contour tillage and minimum tillage during seedbed preparation, and additions of crop residue help to control surface runoff and erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely

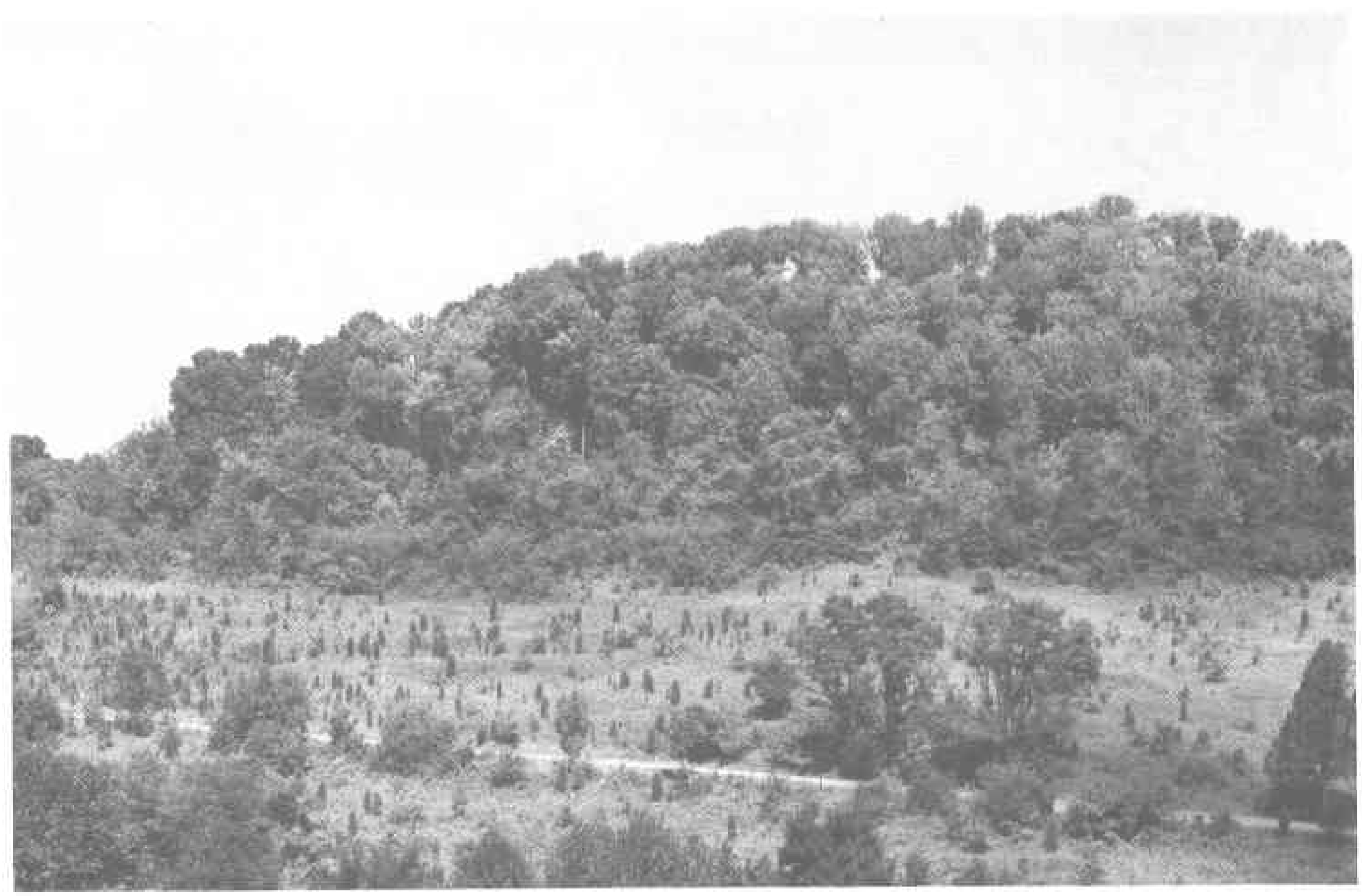

Figure 10.—An idle field reverting to cedars and brush in an area of Pate silt loam, 15 to 25 percent slopes, eroded, on the foot slope in the foreground. Mixed hardwoods are on Eden flaggy silt loam, 25 to 50 percent slopes, eroded, on the upper back slope in the background.

deferment of grazing, and restricted use during wet periods are needed.

This soil is fairly well suited to trees. The erosion hazard, the equipment limitation, seedling mortality, windthrow, and plant competition are management concerns. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, culverts, and drop structures. The use of equipment is limited when the soil is wet and sticky. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the shrink-swell potential, the slope, low strength, soil slippage, and the very slow permeability, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is VIe. The woodland ordination symbol is 5R.

PkB—Pekin silt loam, rarely flooded, 1 to 4 percent slopes. This gently sloping, deep, moderately well drained soil is on old stream terraces. It is subject to rare flooding of brief duration in winter and spring. Individual areas are irregularly shaped and are 5 to 40 acres in size. The dominant size is about 10 acres.

In a typical profile, the surface layer is about 13 inches of dark brown silt loam. The subsoil is about 44 inches thick. The upper part is yellowish brown, friable and firm, brittle silt loam; the next part is a fragipan of brown, very firm, brittle silt loam; and the lower part is strong brown and yellowish brown, friable silt loam. The substratum to a depth of 60 inches is yellowish brown silt loam that has thin strata of loam and loamy sand. In some small areas the subsoil has layers that are very firm and brittle in less than 60 percent of the volume.

Included with this soil in mapping are small areas of the well drained Elkinsville soils on terraces near slope breaks and drainageways. These soils do not have a fragipan. Also included, near the center of the terraces and in swales and depressions, are small areas of somewhat poorly drained soils that formed in acid, silty material and have a fragipan. Included soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Pekin soil. Permeability is very slow. Organic matter content is moderate in the surface layer. Surface runoff is medium in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled. A seasonal high water table is at a depth of 2 to 6 feet late in winter and in spring.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture or are wooded.

This soil is well suited to corn, soybeans, and small grain. Erosion is a hazard in areas where the slope is 2 to 4 percent. The very slowly permeable fragipan is the major limitation. Crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, cover crops, and green manure crops help to maintain or improve tilth and the organic matter content.

This soil is well suited to grasses for hay and pasture but is poorly suited to deep-rooted legumes, such as alfalfa, because the very slowly permeable fragipan restricts root penetration and the downward movement of water. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The hazards and limitations that affect planting and harvesting are slight.

Because of the flooding, frost action, low strength, the wetness, and the very slow permeability, this soil is severely limited as a site for buildings, local roads and streets, and septic tank absorption fields. Subsurface drains help to lower the water table. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. Enlarging septic tank absorption fields helps to overcome the restricted permeability. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIe. The woodland ordination symbol is 4A.

RoA—Rossmoyne silt loam, 0 to 2 percent slopes. This deep, moderately well drained, nearly level soil is on narrow summits in the uplands. Individual areas are narrow and irregularly shaped and are 10 to 200 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 9 inches of dark brown silt loam. The subsoil extends to a depth of 80 inches. The upper part is yellowish brown, mottled, friable silt loam and yellowish brown, mottled, firm silty clay loam; the next part is a fragipan of yellowish brown, mottled, very firm, brittle silt loam; and the lower part is yellowish brown and strong brown, mottled, firm silt loam and clay loam. In some small areas the soil is well drained. In places it is underlain by interbedded limestone and calcareous shale bedrock.

Included with this soil in mapping are small areas of the somewhat poorly drained Avonburg soils on broad summits near tabular divides. These soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Rossmoyne soil. Permeability is slow. Organic matter content is moderate in the surface layer. Surface runoff is slow in cultivated areas. The fragipan restricts root penetration and the downward movement of water. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content. A perched water table is at a depth of 1.5 to 3.0 feet during winter and spring.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture. A few small areas are used as woodland.

This soil is well suited to corn, soybeans, small grain, and tobacco (fig. 11). The main limitations are the seasonal high water table and the slowly permeable fragipan. Also, drought can damage crops during periods when rainfall is below normal or is poorly distributed. Crop residue management and cover crops improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Plant competition, windthrow, and seedling mortality are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to

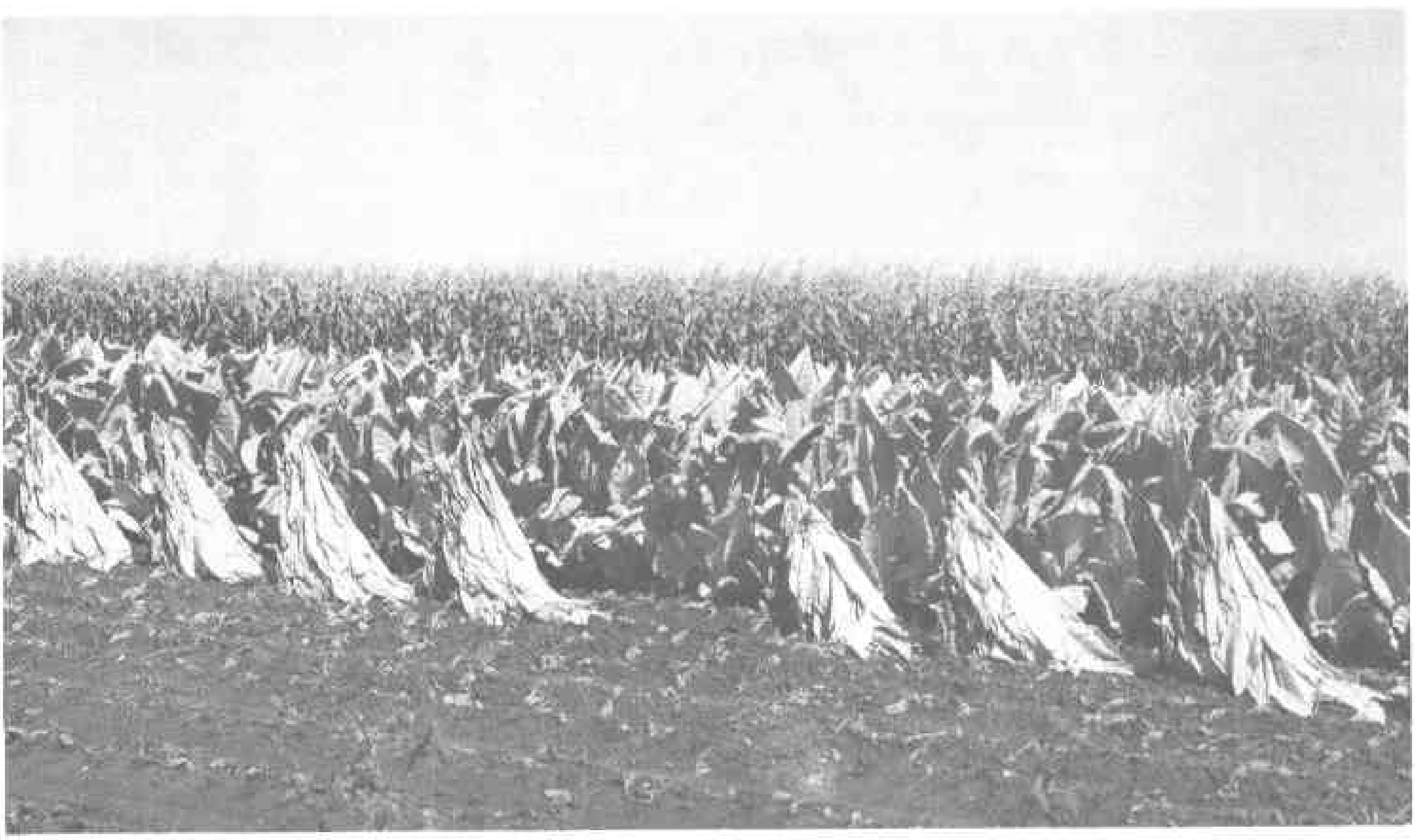

Figure 11.—Tobacco and corn on Rossmoyne silt loam, 0 to 2 percent slopes.

prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of frost action and low strength. The base material for the roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the slow permeability and the wetness, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to overcome the restricted permeability. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIw. The woodland ordination symbol is 3D.

RoB2—Rossmoyne silt loam, 2 to 6 percent slopes, eroded. This deep, moderately well drained, gently sloping soil is on summits, shoulder slopes, and the upper part of back slopes in the uplands. Individual areas are narrow and irregularly shaped and are 10 to 60 acres in size. The dominant size is about 40 acres.

In a typical profile, the surface layer is about 8 inches of dark brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil is more than 60 inches thick. The upper part is yellowish brown, mottled, friable silt loam and firm silty clay loam; the next part is a fragipan of yellowish brown, mottled, very firm, brittle silty clay loam; and the lower part is yellowish brown, firm clay loam. In some small areas the soil is well drained. In places it is underlain by interbedded limestone and calcareous shale bedrock.

Included with this soil in mapping are a few areas of the nearly level, somewhat poorly drained Avonburg soils in the center of the summits. These soils make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Rossmoyne soil. Permeability is slow. Organic matter content is moderate in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content. A perched water table is at a depth of 1.5 to 3.0 feet during winter and spring.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops. A few small areas are used as woodland.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, windthrow, and plant competition are the main management concerns. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Seedlings survive and grow well if competing vegetation is controlled and livestock is excluded from the wooded areas. Selection of proper planting stock and limited overstocking reduce the seedling mortality rate. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of frost action and low strength. The base material for the roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the slow permeability and the wetness, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent. Subsurface perimeter or interceptor drains help to lower the water table.

The land capability classification is IIe. The woodland ordination symbol is 3D.

SwB2—Switzerland silt loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, well drained soil is on summits and shoulder slopes in the uplands. Individual areas are narrow and elongated and are 5 to 60 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 8 inches of dark yellowish brown silt loam mixed with a small amount of yellowish brown silty clay loam. The subsoil is about 52 inches thick. The upper part is dark yellowish brown and yellowish brown, firm silt loam and silty clay loam, and the lower part is yellowish brown and light olive brown, very firm clay. The substratum to a depth of 80 inches is light olive brown, calcareous flaggy clay. In places the soil has more clay in the surface layer and subsoil and is not so deep over bedrock. In some areas gray mottles are in the upper part of the soil.

Included with this soil in mapping are small areas of moderately well drained soils that have a fragipan. These soils are near the center of the summits. They make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Switzerland soil. Permeability is moderate in the upper part of the subsoil and very slow in the lower part. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops, wildlife habitat, or woodland.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements and is severely limited as a site for dwellings with basements. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of frost action and low strength. The base material for the roads and streets should be strengthened or replaced with better suited material. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the very slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent.

The land capability classification is IIe. The woodland ordination symbol is 5A.

SwC2—Switzerland silt loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on summits, shoulder slopes, and back slopes in the uplands. Individual areas are narrow and elongated and are 5 to 100 acres in size. The dominant size is about 35 acres.

In a typical profile, the surface layer is about 10 inches of dark brown silt loam mixed with a small amount of strong brown subsoil material. The subsoil is about 38 inches thick. The upper part is strong brown, firm silty clay loam and very firm silty clay and clay, and the lower part is light olive brown, very firm clay. The substratum is light olive brown very channery silty clay loam about 17 inches thick. Interbedded shale and limestone bedrock is at a depth of about 65 inches. In some areas the soil has reddish, clayey material in the lower part of the subsoil and is underlain by hard limestone bedrock.

Included with this soil in mapping are small areas of moderately well drained soils near the center of the summits. These soils have a fragipan. They make up 6 to 10 percent of the unit.

Available water capacity is moderate in the Switzerland soil. Permeability is moderate in the upper part of the subsoil and very slow in the lower part. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for hay and pasture. Some are used for row crops, wildlife habitat, or woodland.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture (fig. 12). A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation or by spraying, cutting, or girdling.

Because of the shrink-swell potential, this soil is severely limited as a site for dwellings with basements. It is moderately limited as a site for dwellings without basements because of the slope and the shrink-swell potential. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Land shaping and installing retaining walls help to overcome the slope. The soil is severely limited as a site for local roads and streets because of frost action and low strength. The base material for the roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed, and the roads should be built on the contour if possible.

Because of the very slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to overcome the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

Ud—Udorthents, loamy. These nearly level to very steep, shallow to deep, moderately well drained or well drained soils are around highways, boat docks, sanitary landfills, and quarries on uplands, terraces, and bottom land. In some places, deep cuts have been made in the original land surface and the soil material is used to fill in lower areas, which are then smoother and more nearly level. In other places the soil material has been removed

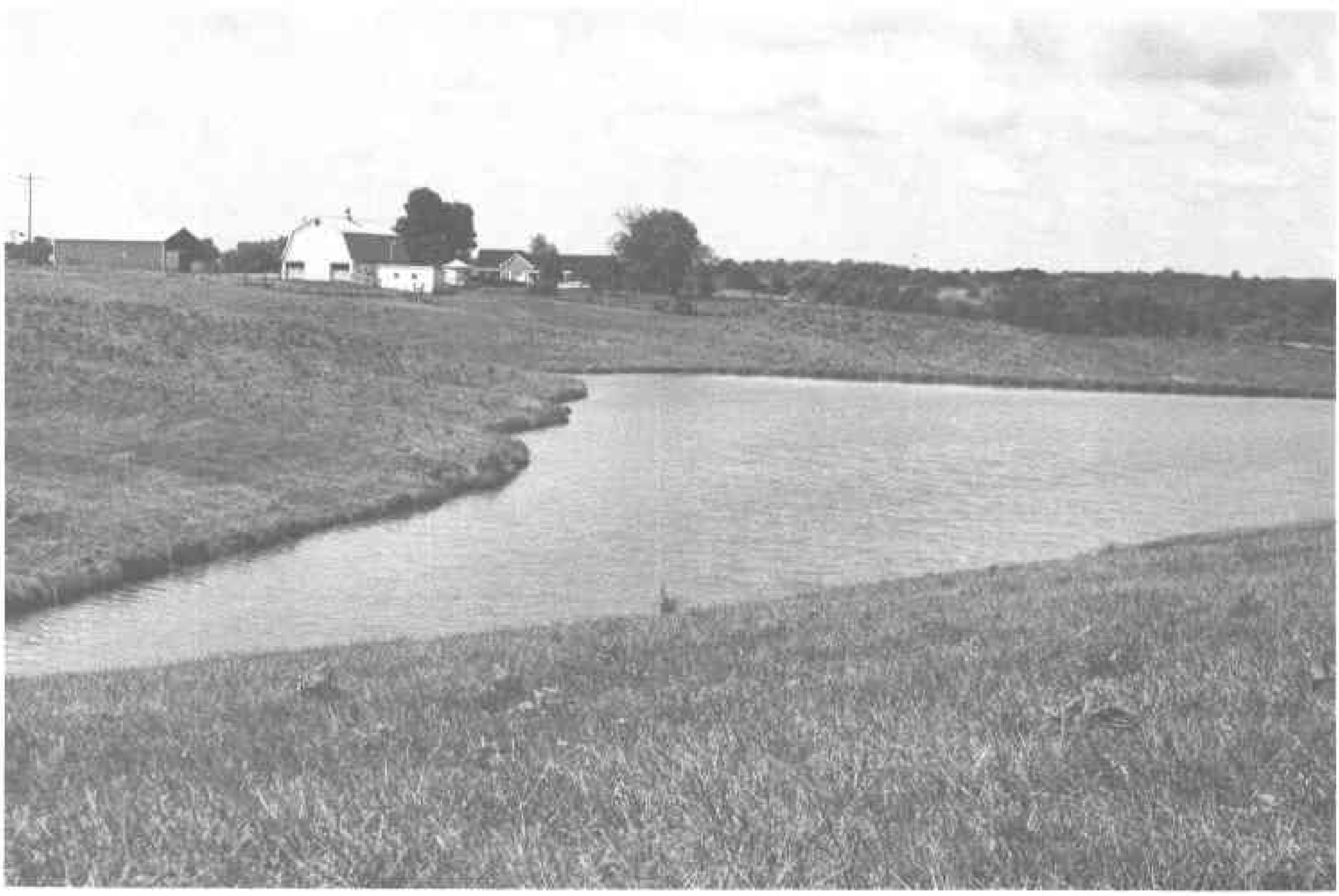

Figure 12.—Farm pond and fescue pasture in an area of Switzerland silt loam, 6 to 12 percent slopes, eroded.

and used as fill in lower areas off the site. In some areas sand, gravel, and loamy or clayey material have been removed or spread over the surface. Individual areas are 3 to 30 acres in size. The dominant size is about 15 acres.

In a typical area of fill, the surface soil, subsoil, and substratum are mixed. The texture is silt loam, loam, silty clay loam, clay loam, and sandy loam. In some areas deep cuts have exposed clayey soil material, limestone fragments, and interbedded limestone and calcareous shale.

Included with these soils in mapping are small areas of somewhat poorly drained soils; short steep slopes; escarpments; areas where bedrock crops out; and, on terraces along the Ohio River, sandy soils that contain gravel. Also included are some areas where highways, streets, buildings, and concrete and metal structures cover much of the surface.

Available water capacity is low or moderate in the Udorthents. Permeability is moderate to slow. Organic matter content is low in the surface soil material. Reaction is very strongly acid to mildly alkaline.

Most areas have a permanent cover of grasses or low-growing shrubs. Many are surrounded by heavily traveled highways. Special management is needed on these soils. An intensified fertility program with special emphasis on the incorporation of organic residue or manure into the soil material is needed if cultivated crops are grown. Measures that help to control erosion are needed in the gently sloping to very steep areas. Diversions, terraces, grade stabilization structures, and grassed waterways are examples. Exposed areas should be revegetated as soon as possible after construction.

Onsite investigation is needed if these soils are to be used as building sites. The depth to gravel or bedrock should be considered. Engineering test data should be collected. The soil properties that affect the design of a structure vary within short distances. Removing as little vegetation as possible from the building site and establishing a protective plant cover as soon as possible help to control erosion. The limitations that affect sanitary facilities vary. As a result, onsite investigation is needed. Restricted permeability, clayey material, the slope, the content of coarse fragments, and the depth to gravel or bedrock can affect these facilities.

The land capability classification is VIe. No woodland ordination symbol is assigned.

WgB2—Weisburg silt loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, well drained soil is on narrow summits and shoulder slopes in the uplands. Individual areas are narrow and irregularly shaped and are 5 to 30 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 8 inches of dark yellowish brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil extends to a depth of 80 inches. In sequence downward, it is yellowish brown, friable and firm silty clay loam; yellowish brown, mottled, firm clay loam; a fragipan of yellowish brown and strong brown, mottled, very firm, brittle silty clay loam and clay loam; and yellowish brown, mottled, very firm clay. In some small areas the soil is moderately well drained. In other small areas it is underlain by calcareous glacial till.

Included with this soil in mapping are a few small areas of the moderately sloping, well drained Bonnell and Switzerland soils on the slightly lower back slopes. These soils do not have a fragipan. They make up 8 to 10 percent of the unit.

Available water capacity is moderate in the Weisburg soil. Permeability is very slow. Organic matter content is moderate in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops. A few small areas are wooded.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation, or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after the seedlings are planted.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements and is severely limited as a site for dwellings with basements. Strengthening foundations, footings, and basements walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of frost action. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the slow permeability in the fragipan, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent.

The land capability classification is IIe. The woodland ordination symbol is 4A.

WgC2—Weisburg silt loam, 6 to 12 percent slopes, eroded. This deep, moderately sloping, well drained soil is on summits, shoulder slopes, and back slopes in the uplands. Individual areas are narrow and elongated and are 10 to 40 acres in size. The dominant size is about 15 acres.

In a typical profile, the surface layer is about 7 inches of dark yellowish brown silt loam mixed with a small amount of yellowish brown silt loam. The subsoil extends to a depth of 80 inches. The upper part is yellowish brown and dark yellowish brown, friable silt loam; the next part is a fragipan of strong brown and yellowish brown, mottled, very firm, brittle loam and clay loam; and the lower part is yellowish brown, mottled, very firm clay. In some areas the depth to clayey residuum is more than than 72 inches.

Included with this soil in mapping are the moderately well drained Rossmoyne soils near the center of the summits. Also included, on the lower part of the back slopes, are the well drained Switzerland and Carmel soils, which do not have a fragipan. Included soils make up 12 to 15 percent of the unit.

Available water capacity is moderate in the Weisburg soil. Permeability is moderate above the fragipan and very slow in and below the fragipan. Organic matter content is moderate in the surface layer. Surface runoff is rapid in cultivated areas. The fragipan restricts root penetration and the downward movement of water and air. The surface layer generally is strongly acid unless it is limed. It is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops. A few small areas are wooded.

This soil is fairly well suited to corn, soybeans, and small grain. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive surface runoff, and poor tilth. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the shrink-swell potential and the slope, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the shrink-swell potential. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. The soil is severely limited as a site for local roads and streets because of frost action. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the very slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

WhA—Wheeling loam, rarely flooded, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on broad terraces along the Ohio River. Individual areas are irregular in shape and are 30 to 80 acres in size. The dominant size is about 50 acres.

In a typical profile, the surface layer is about 6 inches of dark brown loam. The subsoil is about 63 inches thick. The upper part is dark brown and strong brown, friable fine sandy loam and very fine sandy loam, and the lower part is yellowish brown and strong brown, friable loam, silt loam, and silt. The substratum to a depth of 80 inches is light yellowish brown loamy fine sand and stratified sand and gravel. In some small areas the lower part of the subsoil has gray mottles. In places the subsoil has more silt and less sand.

Included with this soil in mapping are small areas of well drained soils on high terraces and valley trains along the Ohio River. These soils formed in loamy outwash 20 to 40 inches deep over stratified, calcareous sand and gravel. Also included are small areas of the well drained Huntington soils on bottom land along the Ohio River and small areas of the moderately well drained Pekin soils near the center of the stream terraces. Huntington soils formed in neutral recent alluvium. Pekin soils have a fragipan. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Wheeling soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is slow. The surface layer is friable and can be easily worked. It is strongly acid unless it is limed.

Most areas of this soil are used for cultivated crops. Some are used for pasture and hay or for urban development.

This soil is well suited to corn, soybeans, and small grain. No serious limitations or hazards affect cropping. A system of conservation tillage that leaves protective amounts of crop residue on the surface, cover crops, and green manure crops improve or maintain tilth and the organic matter content. Subsurface tile is needed in seepy areas in some drainageways and swales.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is severe. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of rare flooding, this soil is severely limited as a site for buildings. It is moderately limited as a site for local roads and streets because of the rare flooding, frost action, and low strength. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing roads and buildings on raised, well compacted fill material and providing adequate roadside ditches and culverts help to prevent the damage caused by flooding and frost action. The soil is severely limited as a site for septic tank absorption fields because of a poor filtering capacity, which can result in the pollution of ground water supplies. Adding better suited fill material improves the filtering capacity.

The land capability classification is I. The woodland ordination symbol is 4A.

WhB—Wheeling loam, rarely flooded, 2 to 8 percent slopes. This gently sloping and moderately sloping, deep, well drained soil is on old stream terraces. It is higher on the landscape than the adjoining alluvial soils. Individual areas are irregularly shaped and are 5 to 100 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is about 11 inches of dark brown loam. The subsoil is strong brown, friable loam about 47 inches thick. The substratum to a depth of about 80 inches is yellowish brown fine sandy loam. In some small areas the surface layer is silt loam. In other small areas the surface layer and subsoil have less sand and more silt.

Included with this soil in mapping are small areas of the well drained Huntington soils, which formed in neutral recent alluvium on bottom land along the Ohio River. Also included, near the center of the stream terraces, are small areas of the moderately well drained Pekin soils, which have a fragipan. Included soils make up 8 to 10 percent of the unit.

Available water capacity is high in the Wheeling soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is medium in cultivated areas. The surface layer is friable and can be easily worked. It generally is strongly acid unless it is limed.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture.

This soil is well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses and legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is severe. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the rare flooding, this soil is severely limited as a site for buildings. It is moderately limited as a site for local roads and streets because of the rare flooding, low strength, and frost action. The base material for local roads and streets should be strengthened or replaced with better suited material. Constructing roads and buildings on raised, well compacted fill material and providing adequate roadside ditches and culverts help to prevent the damage caused by flooding and frost action. The soil is severely limited as a site for septic tank absorption fields because of a poor filtering capacity, which can result in the pollution of ground water supplies. Adding better suited fill material improves the filtering capacity.

The land capability classification is IIe. The woodland ordination symbol is 4A.

WhC—Wheeling loam, rarely flooded, 8 to 15 percent slopes. This moderately sloping and strongly sloping, deep, well drained soil is on back slopes on stream terraces. Individual areas are irregularly shaped and are 5 to 40 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is about 10 inches of dark brown loam. The subsoil is about 38 inches thick. It is strong brown and friable. The upper part is silt loam, the next part is loam, and the lower part is silt loam. The substratum to a depth of about 60 inches is yellowish brown sandy loam. In places the surface layer and subsoil have more silt. In some small areas they have less sand.

Included with this soil in mapping are small areas of the well drained Huntington soils on bottom land. These soils are more silty than the Wheeling soil. They formed in neutral recent alluvium. Also included, on high terraces and valley trains along the Ohio River, are some small areas of well drained soils that formed in loamy outwash over stratified, calcareous sand and gravel and some areas where gravel is on or near the surface. Included soils make up 4 to 10 percent of the unit.

Available water capacity is high in the Wheeling soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is medium in cultivated areas. The surface layer is friable and can be easily worked. It generally is slightly acid or neutral.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, parallel terraces, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is severe. It can be controlled by adequate site preparation or by spraying, cutting, or girdling. Measures that control competing plants are especially important during the first few years after seedlings are planted.

Because of the rare flooding, this soil is severely limited as a site for buildings. It is moderately limited as a site for local roads and streets because of the rare flooding, frost action, low strength, and the slope. The base material for the roads and streets should be strengthened or replaced with better suited material. Constructing roads and buildings on raised, well compacted fill material and providing adequate roadside ditches and culverts help to prevent the damage caused by flooding and frost action. Constructing the roads on the contour and land shaping help to overcome the slope. The soil is severely limited as a site for septic tank absorption fields because of a poor filtering capacity, which can result in the pollution of ground water supplies. Adding better suited fill material improves the filtering capacity.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

WhE—Wheeling loam, rarely flooded, 18 to 35 percent slopes. This moderately steep and steep, deep, well drained soil is on the back slopes of escarpments on stream terraces. Individual areas are narrow and irregularly shaped and are 10 to 40 acres in size. The dominant size is about 20 acres.

In a typical profile, the surface layer is dark yellowish brown loam about 8 inches thick. The subsoil is about 40 inches thick. The upper part is strong brown, friable loam, and the lower part is yellowish brown and strong brown, very friable, stratified loamy fine sand and loam. The substratum to a depth of 60 inches is yellowish brown, very friable loamy fine sand. In some small areas the surface layer and subsoil have less clay. In some areas gravel is below a depth of 30 inches.

Included with this soil in mapping are small areas of the well drained Huntington soils, which formed in alluvium on bottom land. These soils make up 4 to 10 percent of the unit.

Available water capacity is high in the Wheeling soil. Permeability is moderate. Organic matter content is moderate in the surface layer. Surface runoff is rapid. The surface layer generally is slightly acid.

Most areas of this soil are used as woodland. Some are used for hay and pasture. A few are used as wildlife habitat.

Because of the slope and a severe hazard of erosion, this soil is generally unsuited to cultivated crops. It is fairly well suited to grasses and legumes for pasture, but it is poorly suited to hay because of the slope. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet can damage the sod, reduce plant density and forage yields, and cause surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The erosion hazard, the equipment limitation, and plant competition are the main management concerns. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, culverts, and drop structures. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on these slopes.

Because of the slope, this soil is generally unsuitable for building site development and sanitary facilities. An alternative site should be selected.

The land capability classification is VIe. The woodland ordination symbol is 4R.

WvC—Woolper silty clay loam, 3 to 10 percent slopes. This gently sloping and moderately sloping, deep, well drained soil is on toe slopes and fans in the uplands. Individual areas are narrow and elongated and are 2 to 20 acres in size. The dominant size is about 5 acres.

In a typical profile, the surface layer is about 5 inches of dark brown silty clay loam. The subsoil is about 52 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark brown and dark yellowish brown, very firm silty clay. The substratum to a depth of about 60 inches is dark yellowish brown silty clay. In some places the surface layer is light colored. In other places it is the channery or flaggy analogs of silt loam or silty clay loam. In some small areas the soil formed in material weathered from interbedded limestone and calcareous shale.

Included with this soil in mapping are small areas of the well drained Dearborn soils, which formed in local alluvium on toe slopes, fans, and bottom land. These soils are more channery and flaggy than the Woolper soil. They make up 6 to 10 percent of the unit.

Available water capacity is moderate in the Woolper soil. Permeability is moderately slow. Organic matter content is moderate in the surface layer. Surface runoff is medium. The surface layer is friable and can be easily worked. It generally is slightly acid or neutral.

Most areas of this soil are used for hay and pasture. Some are used for cultivated crops, wildlife habitat, or woodland.

This soil is fairly well suited to corn, soybeans, small grain, and tobacco. If cultivated crops are grown, measures that help to control erosion and surface runoff are needed. Examples are crop rotations that include grasses or legumes, no-till farming and other conservation tillage systems that leave protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Crop residue management and cover crops help to control erosion and improve or maintain tilth and the organic matter content.

This soil is well suited to grasses and legumes for hay and pasture. A cover of grasses and legumes is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, poor tilth, and excessive surface runoff. Proper seeding rates, measures that maintain fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition and the equipment limitation are the main management concerns. Unwanted trees and shrubs can be removed by adequate site preparation or by spraying, cutting, or girdling. Measures that control the competing plants are especially important during the first few years after seedlings are planted. The use of equipment is limited when the soil is wet and sticky.

Because of the shrink-swell potential and the slope, this soil is moderately limited as a site for buildings. It is severely limited as a site for local roads and streets because of low strength. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The base material for local roads and streets should be strengthened or replaced with better suited material. Cutting and filling are needed. The roads should be built on the contour if possible. The soil is severely limited as a site for septic tank absorption fields because of the moderately slow permeability. Installing the absorption field in suitable fill material improves the capacity of the field to absorb effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 32,587 acres in the survey area, or nearly 23 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in general soil map units 1, 2, and 3, which are described under the heading "General Soil Map Units." Nearly all of this prime farmland is used for crops. The crops grown on this land, mainly corn, soybeans, and tobacco, account for an estimated one-half of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Leonard Jordan and William Moran, district conservationists, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 100,000 acres in the county was used for crops, hay, and pasture in 1980 (*7*). Of this total, about 17,000 acres was used for row crops, mainly corn, soybeans, and tobacco; 2,000 acres for close-growing crops, mainly wheat and oats; 30,321 acres for permanent or rotation hay, mainly alfalfa, fescue, red clover, orchardgrass, timothy, and bromegrass; and 52,664 acres for permanent pasture, mainly of fescue, orchardgrass, bluegrass, and white clover. The rest was either idle land or was used for conservation purposes (*5, 7*).

The potential of the soils in Switzerland County for increased production of food is good. The county has 74,805 acres of potential cropland, of which a significant acreage is used as woodland or pasture. In addition to the reserve productive capacity represented by this land, food production can also be increased by extending the latest crop production technology to all of the cropland in the county. This soil survey can greatly facilitate the application of such technology.

The paragraphs that follow describe the major management concerns in the areas of the county used for crops and pasture. These concerns include water erosion, wetness, flooding, droughtiness, fertility, and tilth.

Water erosion is the major management concern on about 51 percent of the cropland, hayland, and pasture in the county. Erosion is a hazard if the slope is more than 2 percent. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and most of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils having a clayey subsoil, such as Bonnell, Carmel, Eden, Markland, Pate, and Woolper soils, and on soils having a layer in or below the subsoil that limits the depth of the root zone. The fragipan in Cincinnati soils, for example, is impermeable to plant roots. The root zone consists of the soil material above the fragipan. Therefore, as the topsoil is removed by erosion, the depth of the root zone is reduced. Second, soil erosion results in sedimentation in streams. Control of erosion minimizes the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and other wildlife.

On clayey spots in many sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded away. Such spots are common in areas of the severely eroded Carmel and Cincinnati soils.

Soil conservation practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a vegetative cover on the surface for extended periods can minimize soil losses and thus help to maintain the productive capacity of the soils. On livestock farms, where forage is needed, including legumes and grasses in the cropping sequence reduces the susceptibility of the more sloping areas to erosion and provides nitrogen and improves tilth for the following crop.

On the more sloping soils, cropping systems that provide a substantial vegetative cover are needed to control erosion unless a system of conservation tillage is applied. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. They are suitable practices on most of the soils in the county but are less successful on the eroded soils and on the soils that have a clayey surface layer. No-till production of corn and soybeans, which is becoming more common, is effective in controlling erosion on most of the soils in the county. It is less successful, however, on the soils that have a clayey surface layer and on wet soils that warm up slowly in the spring.

Diversions, cross-slope drainage ditches, and parallel terraces shorten the length of slopes and thus are effective in reducing the susceptibility to sheet, rill, and gully erosion. They are most practical on deep soils that are highly susceptible to erosion and that are on relatively long, uniform slopes. Terraces reduce soil loss and the associated loss of fertilizer elements, help to prevent the damage to crops and watercourses caused by eroding sediments, and help to eliminate the need for grassed waterways, which take productive land out of row crop production. They also make farming on the contour easier and thus reduce the consumption of fuel and the amount of pesticides entering watercourses. Soils that have bedrock within a depth of 40 inches, those that have a clayey subsoil, and those that have a slope of more than 12 percent are less well suited to diversions, cross-slope drainage ditches, and parallel terraces than other soils.

Grassed waterways are needed in many areas of the gently sloping and moderately sloping soils, such as Cincinnati, Rossmoyne, and Weisburg soils. They also are needed in areas that drain large volumes of water. If grassed waterways are established, some type of structure generally is needed to protect the outlet. A subsurface drainage system is needed if they are established in areas of Avonburg and Rossmoyne soils. Tile drainage is needed in the many seepy areas of Cincinnati and Weisburg soils.

Wetness is the major management concern on about 14 percent of the cropland, hayland, and pasture in the county. Most areas of the poorly drained Cobbsfork and somewhat poorly drained Avonburg and Newark soils are adequately drained for agricultural uses. If adequately drained, these soils are among the more productive soils in the county. Where they are not adequately drained, a drainage system may be needed to reduce the crop damage caused by wetness during most years.

The design of both surface and subsurface drainage systems varies with the kind of soil. Shallow surface drains in combination with land leveling are needed if the poorly drained Cobbsfork soils are intensively row cropped. A subsurface drainage system is somewhat beneficial in areas of these soils. Conservation tillage practices, such as ridge planting, also reduce the wetness.

Flooding is a problem on Chagrin and Huntington soils. These soils are among the most productive soils in the county. They are not suitable for small grain, however, because of the severe crop damage caused by floodwater. The frequently flooded Dearborn and occasionally flooded Newark soils also are unsuited to small grain.

Droughtiness is a major management concern on about 2 percent of the cropland, hayland, and pasture in the county. Bloomfield and Dearborn soils have a low available water capacity. Crop yields are reduced during long dry periods. Fall-seeded crops can make good use of the limited amount of available moisture. Conservation tillage can help to conserve moisture because it leaves a cover of crop residue on the surface.

Soil fertility is naturally low or medium in most of the soils on uplands and terraces in the county. These soils tend to be strongly acid or very strongly acid unless they are limed. Examples are the well drained Bonnell, Carmel, Cincinnati, Switzerland, and Weisburg soils, which are leached. Applications of ground limestone are needed to raise the pH level sufficiently for good production of alfalfa and other crops that grow well only on nearly neutral soils. Available phosphorus and potash levels are naturally low in most of these soils.

The soils on flood plains, such as Chagrin and Huntington soils, are medium acid to neutral. They are naturally higher in content of plant nutrients than most soils on uplands and terraces.

On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. Tilth is primarily dependent on texture, structure, drainage, and the content of organic matter.

Many of the soils used for crops in the county have a silt loam surface layer that is light colored or moderately dark and is low in content of organic matter. Generally, the structure of these soils is moderate or weak, and a surface crust forms after periods of heavy rainfall. In some areas the crust is hard and impervious to water when dry. As a result, it reduces the rate of water infiltration and increases the runoff rate. Regular additions of crop residue, manure, and other organic material can improve soil structure and help to prevent excessive crusting.

Fall plowing generally is not suitable on the soils in the county. Many of the soils are nearly as dense and hard at planting time as they were before they were plowed in the fall. About 74 percent of the cropland is in areas of the more sloping soils that are subject to erosion if they are plowed in the fall. Also, many soils on bottom land are subject to scouring because of flash flooding in winter and early in spring. Fall plowing increases the susceptibility to scouring.

Field crops suited to the soils and climate in the county include many that are commonly grown. Corn and soybeans are the main row crops. Tobacco is grown on a relatively large acreage and provides a relatively large income. Wheat and oats are the chief close-growing crops. Rye could be grown, and grass seed could be produced from bromegrass, orchardgrass, fescue, redtop, and bluegrass.

Specialty crops are of commercial importance in the county. A small acreage is used for vegetables and small fruits. Deep, well drained soils that warm up early in spring are especially well suited to vegetables and small fruits. Examples are the Chagrin, Dearborn, Elkinsville, Huntington, and Wheeling soils that have a slope of less than 6 percent. These soils make up about 10,424 acres in the county. If Chagrin, Dearborn, and Huntington soils are used for specialty crops, measures that control flooding are needed. Specialty crops generally can be planted and harvested earlier on these deep, well drained soils than on other soils in the county.

If adequately drained, the poorly drained and somewhat poorly drained Cobbsfork, Avonburg, and Newark soils are suited to vegetable crops. These soils make up 7,530 acres in the county.

Most of the well drained soils in the county are suitable for orchards and nursery plants. Most of the soils in low positions where frost is frequent and air drainage is poor, however, are poorly suited to early vegetables, small fruits, and orchards.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Michael D. Warner, forester, Soil Conservation Service, helped prepare this section.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

James D. McCall, biologist, Soil Conservation Service, helped prepare this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, soybeans, wheat, oats, sorghum, and sunflowers.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, timothy, bromegrass, bluegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, ragweed, pokeweed, sheep sorrel, dock, crabgrass, and dandelion.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, maple, beech, willow, black walnut, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, Washington hawthorn, and shrub dogwood.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are cattails, smartweed, pondweed, spikerush, wild millet, waterplantain, arrowhead, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, dove, meadowlark, field sparrow, cottontail, woodchuck, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and white-tailed deer.

Habitat for wetland wildlife consists of marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

Edge habitat is the areas where major land uses or cover types adjoin. A good example is the border between dense woodland and a field of no-till corn. Although not rated in the table, edge habitat is of primary importance to animals from the smallest songbirds to white-tailed deer. Most of the animals that inhabit openland or woodland habitat also frequent edge habitat, and desirable edge areas are consistently used by 10 times as many wildlife as are the centers of large areas of woodland or cropland.

Engineering

Max L. Evans, conservation engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, ponding, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, ponding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, ponding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils.

Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

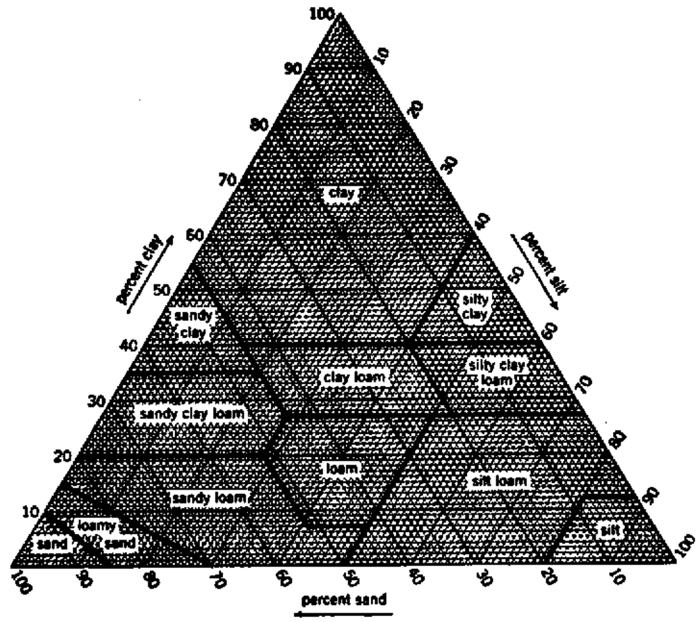

Figure 13.—Percentages of sand, silt, and clay in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*. a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Indiana State Highway Research and Training Center, Purdue University.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*8*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*9*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Avonburg Series

The Avonburg series consists of deep, somewhat poorly drained, very slowly permeable soils on glacial drift plains. These soils formed in a thin mantle of loess and in the underlying glacial drift. Slopes range from 0 to 4 percent.

Avonburg soils generally are adjacent to Cobbsfork and Rossmoyne soils. Cobbsfork soils are grayer in the subsoil than the Avonburg soils and do not have a fragipan within a depth of 50 inches. They are near the center of tabular divides. Rossmoyne soils have fewer grayish mottles in the upper part of the subsoil than the

Avonburg soils. They are on summits, shoulder slopes, and the upper part of back slopes.

Typical pedon of Avonburg silt loam, 0 to 2 percent slopes, in a cultivated field; 600 feet east and 900 feet north of the southwest corner of sec. 5, T. 2 N., R. 2 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; moderate medium subangular blocky structure parting to moderate medium granular; friable; many fine roots; slightly acid; abrupt smooth boundary.

BE—9 to 17 inches; yellowish brown (10YR 5/6) silt loam; many medium distinct light brownish gray (10YR 6/2) and common medium distinct pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; friable; few fine roots; extremely acid; clear smooth boundary.

Btxg1—17 to 27 inches; light brownish gray (10YR 6/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; brittle; thin discontinuous brown (10YR 5/3) clay films on faces of peds; thick discontinuous light gray (10YR 7/2) silt coatings on faces of prisms; extremely acid; gradual wavy boundary.

Btxg2—27 to 47 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; strong very coarse prismatic structure parting to moderate medium subangular blocky; very firm; brittle; thick continuous grayish brown (10YR 5/2) clay films on faces of peds; thick discontinuous light gray (10YR 7/2) silt coatings on faces of prisms; extremely acid; gradual wavy boundary.

2Btxg3—47 to 57 inches; gray (10YR 6/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; thick discontinuous light brownish gray (10YR 6/2) clay films on faces of peds; thick light brownish gray (10YR 6/2) silt coatings in old root channels; few very dark grayish brown (10YR 3/2) iron and manganese oxide stains; few pebbles; very strongly acid; gradual wavy boundary.

2Bx—57 to 70 inches; yellowish brown (10YR 5/6) silty clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; firm; brittle; thick gray (10YR 6/1) silt coatings in old root channels; common very dark grayish brown (10YR 3/2) iron and manganese oxide stains; few pebbles; medium acid; gradual wavy boundary.

2C—70 to 80 inches; yellowish brown (10YR 5/6) silty clay loam; massive; firm; thick gray (10YR 6/1) silt coatings in old crawfish channels; few pebbles; slightly acid.

The thickness of the solum ranges from 60 to more than 80 inches. The thickness of the loess ranges from 20 to 40 inches. The depth to the fragipan is 24 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is strongly acid to neutral. The BE horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 6 and is distinctly mottled. It is silt loam or silty clay loam. It is extremely acid to strongly acid. The Btxg and 2Btxg horizons have hue of 10YR, value of 5 or 6, and chroma of 1 or 2 and are distinctly mottled. They are silt loam, silty clay loam, or clay loam. They are extremely acid to strongly acid. The 2C horizon has hue of 10YR, 2.5Y, or 7.5YR, value of 4 to 6, and chroma of 1 to 6. It is clay loam, loam, silt loam, or silty clay loam. It is strongly acid or very strongly acid in the upper part and very strongly acid to slightly acid in the lower part.

Bloomfield Series

The Bloomfield series consists of deep, well drained or somewhat excessively drained, moderately rapidly permeable or rapidly permeable soils on stream terraces. These soils are on the summits and back slopes of dunes. They formed in sandy eolian deposits. Slopes range from 4 to 12 percent.

These soils are taxadjuncts to the Bloomfield series because the bands of fine sandy loam are higher in the profile than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Bloomfield soils are similar to Wheeling soils and are adjacent to Elkinsville, Wheeling, and Pekin soils in some areas. All of the adjacent soils are more clayey in the solum than the Bloomfield soils.

Typical pedon of Bloomfield loamy fine sand, 4 to 12 percent slopes, in an idle field; 250 feet north and 1,800 feet east of the southwest corner of sec. 16, T. 3 N., R. 12 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

E&Bt1—9 to 13 inches; strong brown (7.5YR 4/6) fine sandy loam occurring as nearly continuous bands 2 to 4 inches thick (Bt); weak medium subangular blocky structure; very friable; many fine roots; clay bridges between sand grains; medium acid; yellowish brown (10YR 5/4) fine sand and loamy fine sand bands about 1 inch thick (E); single grain; loose; common fine roots; medium acid; abrupt wavy boundary.

E&Bt2—13 to 49 inches; yellowish brown (10YR 5/4) fine sand and loamy fine sand bands 3 to 5 inches thick (E); single grain; loose few fine roots in the upper part; slightly acid; dark brown (7.5YR 4/4) fine sandy loam occurring as nearly continuous bands 3 to 13 inches thick (Bt); weak medium and coarse subangular blocky structure; friable; common fine roots; clay bridges between sand grains; medium acid; abrupt wavy boundary.

C—49 to 60 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; slightly acid.

The solum ranges from 4.5 to 7.0 feet in thickness. The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is fine sand, loamy fine sand, or loamy sand. The sandier part of the E&Bt horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is fine sand, loamy sand, or loamy fine sand. Many lamellae in the E&Bt horizon are discontinuous and wavy, joining and separating across a single pedon. The lamellae have hue of 5YR, 7.5YR, or 10YR, value of 3 or 4, and chroma of 3 to 6. They are sandy loam or fine sandy loam. The E&Bt horizon is strongly acid to slightly acid.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is fine sand, loamy sand, or loamy fine sand. It is slightly acid to mildly alkaline.

Bonnell Series

The Bonnell series consists of deep, well drained, slowly permeable soils on glacial drift plains. These soils formed in loess and in the underlying glacial drift. Slopes range from 6 to 25 percent.

Bonnell soils are similar to Carmel soils and generally are adjacent to Eden soils. Carmel soils formed in loess and in material weathered from limestone and shale. Eden soils formed only in residuum, are moderately deep over limestone and shale bedrock, and are on back slopes.

Typical pedon of Bonnell silty clay loam, 15 to 25 percent slopes, eroded, in a pasture; 850 feet north and 2,500 feet west of the southeast corner of sec. 34, T. 5 N., R. 12 E.

Ap—0 to 7 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; mixed with a small amount of yellowish brown (10YR 5/6) silt loam; moderate medium granular structure; friable; many fine roots; very strongly acid; abrupt smooth boundary.

Bt1—7 to 11 inches; yellowish brown (10YR 5/6) silty clay loam; weak medium subangular blocky structure; firm; common fine roots; discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

2Bt2—11 to 18 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous yellowish brown (10YR 5/4) and thin continuous dark yellowish brown (10YR 4/6) clay films on faces of peds; few till pebbles; very strongly acid; gradual wavy boundary.

2Bt3—18 to 27 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous yellowish brown (10YR 5/6) and thin discontinuous yellowish brown (10YR 5/4) clay films on faces of peds; few fine very dark gray (10YR 3/1) iron and manganese oxide stains; few till pebbles; very strongly acid; gradual wavy boundary.

2Bt4—27 to 36 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; firm; thin discontinuous yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine very dark gray (10YR 3/1) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual wavy boundary.

2Bt5—36 to 49 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; firm; thin discontinuous yellowish brown (10YR 5/4 and 5/6) clay films on faces of peds; many fine very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual irregular boundary.

2Bt6—49 to 65 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct light brownish gray (10YR 6/2) and common medium distinct brown (10YR 5/3) mottles; weak coarse angular blocky structure; very firm; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; neutral in the upper part and mildly alkaline in the lower part; gradual wavy boundary.

2C—65 to 80 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; few fine very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; strong effervescence; mildly alkaline.

The solum ranges from 50 to 80 inches in thickness. The loess ranges from 3 to 18 inches in thickness.

The A horizon, if it occurs, has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam, silt loam, or silty clay loam. It ranges from very strongly acid to neutral. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is clay loam, silty clay, or clay. It is very strongly acid to medium acid in the upper part and slightly acid to moderately alkaline in the lower part. The 2C horizon has hue of

10YR, value of 4 or 5, and chroma of 4 to 6. It is loam or clay loam. It is mildly alkaline or moderately alkaline.

Carmel Series

The Carmel series consists of deep, well drained, very slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying material weathered from calcareous shale interbedded with limestone. Slopes range from 6 to 12 percent.

Carmel soils are similar to Bonnell and Eden soils and generally are adjacent to Eden and Switzerland soils. Bonnell soils formed in a thin mantle of loess and in the underlying glacial drift. Eden soils are on back slopes below the Carmel soils and are moderately deep over interbedded limestone and shale. Switzerland soils have a mantle of loess that is thicker than that of the Carmel soils and have a thicker solum.

Typical pedon of Carmel silty clay loam, 6 to 12 percent slopes, eroded, in a pasture; 1,750 feet north and 2,200 feet east of the southwest corner of sec. 11, T. 2 N., R. 3 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; mixed with a small amount of strong brown (7.5YR 5/6) silty clay loam; moderate medium subangular blocky structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

2Bt1—7 to 14 inches; strong brown (7.5YR 5/6) clay; moderate medium subangular blocky structure; very firm; common fine roots; thin discontinuous brown (7.5YR 5/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

2Bt2—14 to 26 inches; yellowish brown (10YR 5/6) clay; few fine distinct light yellowish brown (10YR 6/4) mottles; moderate medium angular blocky structure; very firm; common fine roots; thin discontinuous yellowish brown (10YR 5/4) clay films on faces of peds; discontinuous yellowish brown (10YR 5/4) slickensides; common very dark grayish brown (10YR 3/2) iron and manganese oxide stains; very strongly acid; gradual wavy boundary.

2Bt3—26 to 34 inches; yellowish brown (10YR 5/6) clay; weak medium subangular blocky structure; very firm; thin yellowish brown (10YR 5/4) clay films on faces of peds; common very dark grayish brown (10YR 3/2) iron and manganese oxide stains; neutral; gradual wavy boundary.

2C—34 to 45 inches; light olive brown (2.5Y 5/4) very channery clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium platy fragments; very firm; common dark brown (7.5YR 3/2) iron and manganese oxide stains; about 33 percent channers 0.75 inch to 6 inches long and about 5 percent flagstones 6 to 10 inches long; slight effervescence; mildly alkaline; gradual wavy boundary.

2Cr—45 inches; interbedded soft calcareous clayey shale and limestone flagstones.

The thickness of the solum ranges from 30 to 50 inches and the depth to limestone and calcareous shale from 40 to 60 inches. The thickness of the loess ranges from 6 to 18 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. It is strongly acid to neutral. Some pedons have a Bt horizon. The 2Bt horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 4 or 5, and chroma of 4 to 6. It is silty clay or clay. It is very strongly acid to neutral. The 2C horizon has colors similar to those of the 2Bt horizon. It is slightly acid to strongly alkaline. It is clay or silty clay in which the content of channers and flagstones ranges from 30 to 70 percent.

Chagrin Series

The Chagrin series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in loamy and silty alluvium washed from soils that formed in glacial drift. Slopes range from 0 to 2 percent.

Chagrin soils are similar to Huntington soils and generally are adjacent to Dearborn and Eden soils. Huntington soils have a surface layer that is darker than that of the Chagrin soils. Also, they have more silt and less sand throughout the subsoil. Dearborn soils are more channery and flaggy throughout than the Chagrin soils. Eden soils formed in material weathered from interbedded limestone and calcareous shale. They are on back slopes in the uplands.

Typical pedon of Chagrin silt loam, occasionally flooded, in a cultivated field; 650 feet west and 700 feet north of the center of sec. 28, T. 3 N., R. 3 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 17 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

Bw2—17 to 29 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

Bw3—29 to 37 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

C1—37 to 43 inches; dark brown (10YR 4/3) loam; massive; friable; mildly alkaline; gradual wavy boundary.

C2—43 to 60 inches; dark yellowish brown (10YR 4/4) channery coarse sandy loam; massive; firm; about 20 percent channers and 3 percent flagstones; slight effervescence; mildly alkaline.

The solum typically is 24 to 48 inches thick. It is medium acid to neutral. The content of coarse fragments ranges from 0 to 15 percent to a depth of 40 inches and from 5 to 25 percent below that depth.

The Ap horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 2 or 3. It is silt loam, loam, or sandy loam. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, silt loam, sandy loam, fine sandy loam, or clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam, loam, sandy loam, clay loam, or coarse sandy loam. It is highly stratified in some pedons. It is neutral or mildly alkaline.

Cincinnati Series

The Cincinnati series consists of deep, well drained, slowly permeable soils on glacial drift plains. These soils formed in loess and in the underlying glacial drift. Slopes range from 2 to 12 percent.

These soils are taxadjuncts to the Cincinnati series because they have a lower base saturation than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Cincinnati soils are similar to Rossmoyne and Weisburg soils and generally are adjacent to Bonnell soils. Rossmoyne soils have grayish mottles in the upper part of the subsoil. Weisburg soils formed in a thin mantle of loess and in glacial drift and material weathered from interbedded limestone and shale. Bonnell soils do not have a fragipan. They are on back slopes below the Cincinnati soils.

Typical pedon of Cincinnati silt loam, 2 to 6 percent slopes, eroded, in a cultivated field; 950 feet north and 1,650 feet east of the southwest corner of sec. 33, T. 5 N., R. 12 E.

Ap—0 to 8 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; mixed with a small amount of yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; common fine and medium roots; medium acid; abrupt smooth boundary.

Bt1—8 to 16 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine and medium roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

Bt2—16 to 27 inches; yellowish brown (10YR 5/6) silty clay loam; few fine distinct pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) and few fine faint strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; gradual wavy boundary.

2Btx1—27 to 36 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; firm; brittle; thin discontinuous light brownish gray (10YR 6/2) silt coatings on faces of prisms and in old root channels; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine very dark gray (10YR 3/1) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual wavy boundary.

2Btx2—36 to 51 inches; yellowish brown (10YR 5/4) silt loam; strong very coarse prismatic structure parting to moderate medium subangular blocky; very firm; brittle; medium discontinuous light brownish gray (10YR 6/2) silt coatings on faces of prisms and in old root channels; thin discontinuous grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay films on faces of peds; few fine black (10YR 2/1) iron manganese oxide accumulations and stains; few till pebbles; very strongly acid; gradual wavy boundary.

2Btx3—51 to 64 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct gray (10YR 6/1) mottles; strong very coarse prismatic structure parting to moderate medium subangular blocky; very firm; brittle; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; few till pebbles; very strongly acid; gradual wavy boundary.

2BC—64 to 80 inches; strong brown (7.5YR 5/6) clay loam; common medium distinct red (2.5YR 4/6) and gray (10YR 6/1) mottles; weak medium angular blocky structure; firm; few till pebbles; extremely acid.

The thickness of the solum and the depth to carbonates range from 48 to 100 inches. The thickness of the loess ranges from 18 to 40 inches and the depth to the fragipan from 24 to 38 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is very strongly acid or strongly acid unless it is limed. The Bt and 2Btx horizons are very strongly acid or strongly acid. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, silty clay loam, or loam. The 2Btx horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, silty clay loam, or clay loam. The 2BC horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is extremely acid to medium acid. It is loam, silty clay loam, or clay loam. The content of coarse fragments in this horizon ranges from 0 to 15 percent.

Cobbsfork Series

The Cobbsfork series consists of deep, poorly drained, very slowly permeable soils on glacial drift plains (fig.

14). These soils formed in loess and in the underlying glacial drift. Slope ranges from 0 to 2 percent.

Figure 14.—Profile of Cobbsfork silt loam. The grayish color throughout the profile indicates poor drainage.

Cobbsfork soils generally are adjacent to Avonburg soils. The adjacent soils are browner in the upper part of the subsoil than the cobbsfork soils and have a fragipan within a depth of 50 inches. They are on narrow tabular divides or are near the edge of the divides.

Typical pedon of Cobbsfork silt loam, in a cultivated field; 1,150 feet south and 2,250 feet west of the northeast corner of sec. 6, T. 2 N., R. 2 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) and many medium faint brown (10YR 5/3) mottles; moderate fine granular and subangular blocky structure; friable; many fine roots; strongly acid; clear smooth boundary.

Eg—6 to 11 inches; gray (10YR 6/1) silt loam; common medium distinct yellowish brown and few fine distinct yellowish red (5YR 5/6) mottles; weak medium platy structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

Bg—11 to 21 inches; light brownish gray (10YR 6/2) silt loam; common medium distinct brownish yellow (10YR 6/6) and few medium faint light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; friable; few fine roots; very strongly acid; clear wavy boundary.

Btg—21 to 32 inches; light brownish gray (10YR 6/2) silt loam; common medium distinct brownish yellow (10YR 6/6) and few medium faint light yellowish brown (10YR 6/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous pale brown (10YR 6/3) clay films on faces of peds; very strongly acid; gradual wavy boundary.

2Btxg1—32 to 44 inches; gray (10YR 6/1) silt loam; common medium prominent strong brown (7.5YR 5/6) and few medium distinct brown (10YR 5/3) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; brittle; medium discontinuous gray (10YR 5/1) clay films and thick discontinuous light gray (10YR 7/1) silt coatings on faces of prisms; few very dark gray (10YR 3/1) iron and manganese oxide stains; very strongly acid; gradual wavy boundary.

2Btxg2—44 to 65 inches; gray (10YR 6/1) silt loam; common medium distinct yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/6) mottles; strong coarse prismatic structure parting to moderate medium subangular blocky; very firm; brittle; thick discontinuous light gray (10YR 7/2) silt coatings and medium discontinuous gray (10YR 5/1) clay films on faces of prisms; very strongly acid; gradual wavy boundary.

2Btxg3—65 to 80 inches; gray (10YR 6/1) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate very coarse prismatic structure parting to weak medium subangular blocky; very firm; brittle; thick discontinuous light gray (10YR 7/2) silt coatings and medium discontinuous gray (10YR 5/1) clay films on faces of prisms; slightly acid.

The thickness of the solum is more than 80 inches. It generally is the same as the depth to calcareous glacial till. The thickness of the loess ranges from 36 to 48 inches. Reaction generally is very strongly acid or strongly acid to a depth of 60 inches or more, except for A and E horizons in areas that have been limed.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The Eg horizon has hue of 10YR, value of 5 to 7, and chroma of 1 or 2. The Btg horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2. It has mottles with hue of 10YR or 7.5YR and value and chroma of 4 to 8. It is silt loam or loam. The 2Btxg horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 6. It has mottles with hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 8. It is loam, silt loam, or silty clay loam. Some pedons have a Bx horizon with properties that meet all of the requirements for a fragipan, except for the depth requirement. This horizon is below a depth of 50 inches.

Dearborn Series

The Dearborn series consists of deep, well drained soils on flood plains, toe slopes, and fans. These soils formed in local alluvium washed from soils that formed in glacial drift and in material weathered from interbedded limestone and calcareous shale. Permeability is moderate in the upper part of the profile and moderately rapid in the lower part. Slopes range from 0 to 2 percent.

Dearborn soils are adjacent to Chagrin soils in some areas. The adjacent soils are less channery and flaggy throughout than the Dearborn soils.

Typical pedon of Dearborn loam, frequently flooded, in a cultivated field; 900 feet east and 1,800 feet north of the southwest corner of sec. 17, T. 2 N., R. 3 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many fine medium roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bw—10 to 15 inches; dark brown (10YR 3/3) channery loam, brown (l0YR 5/3) dry; weak medium subangular blocky structure; friable; many fine roots; about 20 percent channers; strong effervescence; mildly alkaline; clear smooth boundary.

C1—15 to 26 inches; dark brown (10YR 4/3) extremely channery coarse sandy loam; massive; very friable; common fine roots; about 65 percent channers; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—26 to 60 inches; dark brown (10YR 4/3) extremely channery loam; massive; very friable; about 65 percent channers and flagstones; strong effervescence; mildly alkaline.

The solum typically is 10 to 20 inches thick. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The Ap horizon has hue of 10YR or 7.5YR, value of 3, and chroma of 2 or 3. It is silt loam, loam, or the channery or flaggy analogs of these textures. The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is loam, silt loam, silty clay loam, clay loam, or the channery analogs of these textures. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, sandy loam, or coarse sandy loam in which the content of channers and flagstones ranges from 15 to more than 60 percent.

Eden Series

The Eden series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous shale interbedded with limestone. Slopes range from 15 to 50 percent.

Eden soils are similar to Pate soils and generally are adjacent to Carmel and Pate soils. Pate soils are deep and are on foot slopes below the Eden soils. The residuum in which these soils formed contains more shale than that of the Eden soils. Carmel soils formed in a thin mantle of loess and in material weathered from the underlying interbedded limestone and calcareous shale. They are deeper to bedrock than the Eden soils. They are on summits, shoulder slopes, and back slopes above the Eden soils.

Typical pedon of Eden flaggy silt loam, 25 to 50 percent slopes, eroded, in a wooded area; 1,600 feet south and 2,300 feet east of the northwest corner of sec. 2, T. 5 N., R. 12 E.

Ap—0 to 5 inches; dark brown (10YR 4/3) flaggy silt loam, pale brown (10YR 6/3) dry; mixed with a small amount of light olive brown (2.5Y 5/4) silty clay loam; moderate fine subangular blocky structure parting to moderate medium granular; friable; many fine and medium roots; about 20 percent flagstones; slightly acid; abrupt smooth boundary.

Bt1—5 to 11 inches; light olive brown (2.5Y 5/4) silty clay; moderate medium angular blocky structure; very firm; common fine and medium roots; thin discontinuous olive (5Y 5/3) clay films on faces of peds; about 10 percent flagstones; strongly acid; gradual wavy boundary.

Bt2—11 to 20 inches; light olive brown (2.5Y 5/4) clay; moderate medium angular blocky structure; very firm; few medium roots; thin continuous olive (5Y 5/3) clay films on faces of peds; about 12 percent flagstones; slight effervescence; mildly alkaline; gradual wavy boundary.

Bt3—20 to 26 inches; olive (5Y 5/4) flaggy silty clay; weak medium angular blocky structure; very firm;

few fine roots; thin discontinuous olive (5Y 5/3) clay films on faces of peds; about 20 percent flagstones; strong effervescence; mildly alkaline; abrupt irregular boundary.

Cr—26 inches; slightly weathered calcareous shale interbedded with strata of fractured limestone; less than 10 percent olive (5Y 5/3), massive clay; very firm; strongly alkaline.

The thickness of the solum ranges from 20 to 40 inches and is about the same as the depth to interbedded limestone and calcareous shale. The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silt loam, silty clay loam, or the flaggy analogs of these textures. It is neutral or mildly alkaline. The Bt horizon has hue of 10YR, 2.5Y, and 5Y, value of 4 or 5, and chroma of 3 to 6. It is silty clay, clay, or the flaggy analogs of these textures. It ranges from neutral to moderately alkaline. The Cr horizon has hue of 5GY to 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 4.

Elkinsville Series

The Elkinsville series consists of deep, well drained, moderately permeable soils on loess-covered terraces. These soils formed in acid, silty material of mixed origin. Slopes range from 0 to 8 percent.

Elkinsville soils are similar to Wheeling soils and generally are adjacent to Huntington and Pekin soils. Wheeling soils have more sand and less silt in the lower part of the solum than the Elkinsville soils. Huntington soils formed in silty recent alluvium on flood plains. Pekin soils have a fragipan and have grayish mottles in the upper part of the subsoil. They are in landscape positions similar to those of the Elkinsville soils.

Typical pedon of Elkinsville silt loam, rarely flooded, 0 to 2 percent slopes, in a cultivated field; 400 feet west and 900 feet south of the center of sec. 22, T. 2 N., R. 3 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

BE—10 to 20 inches; strong brown (7.5YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; thin patchy dark yellowish brown (10YR 4/4) organic coatings on faces of peds; common mica flakes; slightly acid; clear smooth boundary.

Bt1—20 to 26 inches; dark brown (7.5YR 4/4) silt loam; few fine distinct light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; common mica flakes; strongly acid; clear wavy boundary.

Bt2—26 to 33 inches; dark brown (7.5YR 4/4) silt loam; few small pockets of light brownish gray (10YR 6/2) loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; common mica flakes; strongly acid; clear wavy boundary.

Bt3—33 to 45 inches; dark brown (7.5YR 4/4) silt loam; common fine distinct pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; common mica flakes; very strongly acid; clear wavy boundary.

Bt4—45 to 58 inches; dark yellowish brown (10YR 4/4) silt loam; common fine faint pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; common mica flakes; very strongly acid; clear wavy boundary.

C1—58 to 68 inches; yellowish brown (10YR 5/4) silt loam; few fine faint pale brown (10YR 6/3) mottles; massive; friable; common mica flakes; very strongly acid; clear wavy boundary.

C2—68 to 80 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; common mica flakes; very strongly acid.

The solum ranges from 42 to 60 inches in thickness. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, silt loam, or silty clay loam. It is strongly acid or very strongly acid. The C horizon is sandy loam, loam, silty clay loam, or silt loam. It is very strongly acid to medium acid.

Huntington Series

The Huntington series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in silty recent alluvium of mixed origin. The alluvium has a significant amount of limestone residuum. Slopes range from 0 to 2 percent.

Huntington soils are adjacent to Chagrin, Dearborn, Elkinsville, Newark, and Pate soils. Chagrin soils have a surface layer that is lighter colored than that of the Huntington soils. Also, they have less silt and sand throughout the subsoil. Dearborn soils have more channers and flagstones throughout than the Huntington soils. Elkinsville soils formed in loess and in the underlying stratified, silty or loamy sediments. They are on terraces. Newark soils have grayish colors in the upper part of the subsoil and have a surface layer that is lighter colored than that of the Huntington soils. Pate soils formed in material weathered from interbedded limestone and calcareous shale on foot slopes.

Typical pedon of Huntington silt loam, occasionally flooded, in a cultivated field; 370 feet east and 600 feet north of the southwest corner of sec. 32, T. 2 N., R. 3 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; many fine roots; weak effervescence; mildly alkaline; abrupt smooth boundary.

A—8 to 16 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; common fine roots; thin discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds; weak effervescence; mildly alkaline; gradual smooth boundary.

Bw1—16 to 39 inches; dark brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark brown (10YR 3/3) coatings on faces of peds; few mica flakes; neutral; gradual wavy boundary.

Bw2—39 to 50 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark brown (10YR 3/3) coatings on faces of peds; few mica flakes; neutral; gradual wavy boundary.

Bw3—50 to 70 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium subangular blocky structure; firm; thin discontinuous dark brown (10YR 3/3) coatings on faces of peds; common mica flakes; slightly acid; gradual wavy boundary.

BC—70 to 80 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; many mica flakes; medium acid.

The thickness of the solum ranges from 50 to more than 80 inches. The mollic epipedon is 10 to 20 inches thick. Many pedons have few or common mica flakes.

The Ap horizon has hue of 10YR and value and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. It is medium acid to mildly alkaline. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. It is medium acid to neutral. The C horizon, if it occurs, is loam, sandy loam, silt loam, or silty clay loam.

Markland Series

The Markland series consists of deep, well drained and moderately well drained, slowly permeable soils on loess-covered lacustrine terraces. These soils formed in loess and in the underlying calcareous, clayey lacustrine sediments. Slopes range from 1 to 15 percent.

Markland soils are similar to Pate soils and generally are adjacent to Huntington soils. Pate soils are underlain by interbedded limestone and calcareous shale. Huntington soils formed in silty recent alluvium on flood plains.

Typical pedon of Markland silt loam, 8 to 15 percent slopes, eroded, in a cultivated field; 1,300 feet north and 2,500 feet east of the southwest corner of sec. 10, T. 2 N., R. 3 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; mixed with a small amount of dark brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

Bt1—8 to 14 inches; dark brown (10YR 4/3) silty clay loam; moderate medium angular blocky structure; very firm; few fine roots; thin discontinuous dark brown (10YR 4/3) clay films on faces of peds; neutral; gradual smooth boundary.

2Bt2—14 to 26 inches; dark yellowish brown (10YR 4/4) silty clay; moderate medium angular blocky structure; very firm; few fine roots; thick discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear smooth boundary.

2Bt3—26 to 33 inches; yellowish brown (10YR 5/4) silty clay that has a few thin layers of brownish yellow (10YR 6/6) very fine sand; moderate medium angular blocky structure; very firm; thick continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; neutral; gradual wavy boundary.

2Bt4—33 to 38 inches; yellowish brown (10YR 5/4) silty clay that has a few thin layers of yellowish brown (10YR 5/6) very fine sand; weak medium angular blocky structure; very firm; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; violent effervescence; moderately alkaline; gradual wavy boundary.

2C—38 to 60 inches; yellowish brown (10YR 5/4) silty clay that has a few thin layers of yellowish brown (10YR 5/6) very fine sand; massive; very firm; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 40 inches. The solum is medium acid to neutral. The loess is 6 to 15 inches thick.

The Ap or A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam or silty clay loam. The 2Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, silty clay, or clay. The 2C horizon has strata of fine sand, very fine sand, silt loam, silty clay loam, silty clay, or clay. It is mildly alkaline or moderately alkaline.

Newark Series

The Newark series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in silty recent alluvium of mixed origin. The alluvium has a significant amount of limestone residuum. Slopes range from 0 to 2 percent.

Newark soils generally are adjacent to Huntington soils. The adjacent soils have a dark surface layer and do not have grayish colors in the upper part of the subsoil. Their positions on the landscape are similar to those of the Newark soils.

Typical pedon of Newark silt loam, occasionally flooded, in a cultivated field; 250 feet north and 400 feet west of the southeast corner of sec. 32, T. 3 N., R. 1 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; friable; many medium roots; few mica flakes; neutral; clear smooth boundary.

A—7 to 15 inches; dark brown (10YR 4/3) silt loam; moderate medium subangular blocky structure; friable; few fine roots; medium discontinuous grayish brown (10YR 5/2) coatings in root channels and on faces of peds; few mica flakes; neutral; abrupt smooth boundary.

Bg1—15 to 25 inches; grayish brown (10YR 5/2) silt loam; many medium distinct dark brown (7.5YR 4/4 and 10YR 4/3) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; friable; few fine roots; few mica flakes; neutral; clear smooth boundary.

Bg2—25 to 35 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct dark brown (7.5YR 4/4) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; few mica flakes; neutral; clear wavy boundary.

Cg1—35 to 52 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct dark brown (7.5YR 4/4) mottles; massive; firm; few mica flakes; few very dark gray (10YR 3/1) stains; neutral; clear wavy boundary.

Cg2—52 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam; many medium faint dark yellowish brown (10YR 4/4) mottles; massive; firm; few mica flakes; common very dark gray (10YR 3/1) stains; neutral.

The solum ranges from 22 to 44 inches in thickness. It is silt loam or silty clay loam. Reaction is medium acid to mildly alkaline throughout the profile.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. In some pedons is has brownish or grayish mottles. The Bg and Cg horizons have hue of 7.5YR to 2.5Y, value of 4 to 7, and chroma of 1 to 6. The Cg horizon is silt loam or silty clay loam and has thin layers of loam, fine sandy loam, or silty clay in some pedons.

Pate Series

The Pate series consists of deep, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from calcareous shale and limestone. Slopes range from 15 to 25 percent.

Pate soils are similar to Eden, Markland, and Woolper soils and generally are adjacent to Dearborn and Huntington soils. Eden soils are moderately deep over bedrock and are on back slopes. The residuum in which these soils formed contains less shale than that of the Eden soils. Markland soils formed in loess and in the underlying calcareous, clayey lacustrine sediments. They are on terraces. Woolper soils have a surface layer that is darker than that of the Pate soils. They formed in colluvium or alluvium derived from soils that formed in limestone and shale residuum. Dearborn and Huntington soils formed in alluvium on flood plains.

Typical pedon of Pate silt loam, 15 to 25 percent slopes, eroded, in a hay field; 200 feet south and 400 feet west of the northeast corner of sec. 16, T. 2 N., R. 3 W.

Ap—0 to 5 inches; dark brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; mixed with a small amount of dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—5 to 15 inches; dark yellowish brown (10YR 4/4) silty clay; moderate medium subangular blocky structure; very firm; many fine roots; medium continuous dark brown (10YR 4/3) clay films on faces of peds; slightly acid; gradual wavy boundary.

Bt2—15 to 25 inches; dark yellowish brown (10YR 4/4) silty clay; moderate medium angular blocky structure; very firm; common fine roots; thick continuous brown (10YR 5/3) clay films on faces of peds; slightly acid; gradual wavy boundary.

Bt3—25 to 36 inches; yellowish brown (10YR 5/4) silty clay; moderate medium angular blocky structure; very firm; few fine roots; thick continuous grayish brown (2.5Y 5/2) clay films on faces of peds; neutral; gradual wavy boundary.

Bt4—36 to 46 inches; dark yellowish brown (10YR 4/4) silty clay; few fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very firm; medium continuous dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 5 percent channers and 5 percent flagstones; neutral; gradual wavy boundary.

BC—46 to 55 inches; light olive brown (2.5Y 5/4) flaggy clay; many fine faint dark yellowish brown (10YR 4/4) and common fine faint yellowish brown (10YR

5/6) mottles; weak medium subangular blocky structure; very firm; about 17 percent flagstones; slight effervescence; mildly alkaline; gradual wavy boundary.

Cr—55 inches; interbedded limestone and soft calcareous shale.

The thickness of the solum and the depth to limestone and calcareous shale range from 50 to 72 inches. The content of coarse fragments ranges from 0 to 10 percent in the upper part of the solum and from 10 to 50 percent in the lower part. Reaction is medium acid to neutral throughout the solum.

The Ap horizon has hue of 10YR and value and chroma of 3 or 4. It is silt loam or silty clay loam. The Bt1 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or silty clay loam. The Bt2, Bt3, and Bt4 horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. They are silty clay, clay, silty clay loam, or the flaggy analogs of these textures. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of dominantly 3 to 6. In some pedons, however, chroma is 1 or 2 near the paralithic contact. This horizon is the channery, flaggy, very channery, or very flaggy analogs of silty clay loam, silty clay, or clay. It is slightly acid to moderately alkaline.

Pekin Series

The Pekin series consists of deep, moderately well drained, very slowly permeable soils on stream terraces. These soils formed in acid, silty material of mixed origin. Slopes range from 1 to 4 percent.

Pekin soils are similar to Rossmoyne soils and are adjacent to Elkinsville soils in some areas. Rossmoyne soils formed in loess and in the underlying glacial drift. They do not have a stratified substratum. Elkinsville soils do not have a fragipan and do not have grayish mottles in the upper part of the subsoil.

Typical pedon of Pekin silt loam, rarely flooded, 1 to 4 percent slopes, in a cultivated field; 100 feet west and 1,850 feet south of the northeast corner of sec. 22, T. 2 N., R. 3 W.

Ap—0 to 13 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

BE—13 to 17 inches; yellowish brown (10YR 5/4) silt loam; common medium faint pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; few fine roots; few mica flakes; slightly acid; clear smooth boundary.

Bt—17 to 22 inches; yellowish brown (10YR 5/6) silt loam; common medium distinct pale brown (10YR 6/3) and few fine faint strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous yellowish brown (10YR 5/4) clay films on faces of peds; few mica flakes; strongly acid; clear wavy boundary.

Btx1—22 to 33 inches; yellowish brown (10YR 5/4) silt loam; common medium faint light brownish gray (10YR 6/2) and common fine faint strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; brittle; thin discontinuous brown (10YR 5/3) clay films on faces of peds; few mica flakes; very strongly acid; gradual wavy boundary.

Btx2—33 to 43 inches; brown (10YR 5/3) silt loam; many medium distinct yellowish red (5YR 5/8) and common medium faint light brownish gray (10YR 6/2) and dark yellowish brown (10YR 4/6) mottles; strong very coarse prismatic structure parting to moderate medium subangular blocky; very firm; brittle; medium discontinuous brown (10YR 5/3) and grayish brown (10YR 5/2) clay films on faces of peds; few mica flakes; extremely acid; gradual wavy boundary.

B't1—43 to 52 inches; strong brown (7.5YR 5/6) silt loam; common fine distinct light brownish gray (10YR 6/2) mottles; weak medium angular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; few mica flakes; very strongly acid; gradual wavy boundary.

B't2—52 to 57 inches; yellowish brown (10YR 5/6) silt loam; few fine distinct light brownish gray (10YR 6/2) mottles; weak medium angular blocky structure; friable; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; few mica flakes; very strongly acid; gradual wavy boundary.

C—57 to 60 inches; yellowish brown (10YR 5/4) silt loam that has thin strata of loam and loamy sand; single grain; very friable; common mica flakes; very strongly acid.

The thickness of the solum ranges from 48 to 60 inches. The depth to the fragipan is 24 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is medium acid to neutral. The upper Bt horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 3 to 6. It is silt loam or silty clay loam. It is very strongly acid or strongly acid. The Btx and B't horizons have hue of 10YR, value of 5 or 6, and chroma of 2 to 8. The Btx horizon is extremely acid to strongly acid. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 6. It is silt loam, loam, sandy loam, or silty clay loam and is stratified in the lower part. It is very strongly acid to neutral.

Rossmoyne Series

The Rossmoyne series consists of deep, moderately well drained, slowly permeable soils on glacial drift plains. These soils formed in a thin mantle of loess and in the underlying glacial drift. Slopes range from 0 to 6 percent.

Rossmoyne soils are similar to Cincinnati soils and generally are adjacent to Avonburg soils. Cincinnati soils do not have grayish mottles in the upper part of the subsoil. Avonburg soils are grayer in the upper part of the subsoil than the Rossmoyne soils. They are on tabular divides and on back slopes.

Typical pedon of Rossmoyne silt loam, 0 to 2 percent slopes, in a cultivated field; 100 feet south and 1,500 feet east of the northwest corner of sec. 3, T. 3 N., R. 12 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; mixed with a small amount of yellowish brown (10YR 5/6) silt loam; moderate fine and medium subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—9 to 16 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous yellowish brown (10YR 5/6) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—16 to 22 inches; yellowish brown (10YR 5/6) silt loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) clay films on faces of peds; strongly acid; clear smooth boundary.

Btx1—22 to 29 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; brittle; few fine roots; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; thin discontinuous light gray (10YR 7/2) silt coatings on faces of prisms; extremely acid; gradual wavy boundary.

2Btx2—29 to 41 inches; yellowish brown (10YR 5/6) silt loam; common fine distinct light brownish gray (10YR 6/2) mottles; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; discontinuous light gray (10YR 7/2) silt coatings on faces of prisms; few till pebbles; extremely acid; gradual wavy boundary.

2Btx3—41 to 52 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6) and common medium distinct strong brown (7.5YR 5/6) mottles; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; medium discontinuous grayish brown (10YR 5/2) clay films on faces of peds; discontinuous light gray (10YR 7/2) silt coatings on faces of prisms; few till pebbles; extremely acid; gradual wavy boundary.

2Btx4—52 to 60 inches; yellowish brown (10YR 5/6) silt loam; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; thin discontinuous grayish brown (10YR 5/2) clay films on faces of prisms; few very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual wavy boundary.

2Bt1—60 to 72 inches; yellowish brown (10YR 5/4) silt loam; common medium faint strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on faces of prisms; few very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; strongly acid; gradual wavy boundary.

2Bt2—72 to 80 inches; strong brown (7.5YR 5/6) clay loam; weak coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; common very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; neutral.

The thickness of the solum and the depth to carbonates range from 60 to 120 inches. The thickness of loess ranges from 18 to 40 inches and the depth to the fragipan from 24 to 36 inches. The depth to clayey residuum ranges from 72 inches to more than 12 feet.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is very strongly acid or strongly acid unless lime has been applied. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It has mottles with hue of 10YR, value of 5 or 6, and chroma of 2 or less in the lower part. It is silt loam or silty clay loam. It is very strongly acid to slightly acid. The Btx and 2Btx horizons are loam, clay loam, silty clay loam, or silt loam. The Btx horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It has mottles with hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. It is extremely acid to strongly acid. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is strongly acid to neutral.

Switzerland Series

The Switzerland series consists of deep, well drained soils on uplands. These soils formed in a thin mantle of loess and in the underlying material weathered from calcareous shale interbedded with limestone. Permeability is moderate in the upper part of the profile and very slow in the lower part. Slopes range from 2 to 12 percent.

These soils are taxadjuncts to the Switzerland series because they do not have strongly contrasting textures in the control section. This difference, however, does not alter the usefulness or behavior of the soils.

Switzerland soils are similar to Carmel soils. The similar soils have a mantle of loess that is thinner than that of the Switzerland soils. Also, they have a thinner solum.

Typical pedon of Switzerland silt loam, 6 to 12 percent slopes, eroded, in a pasture; 750 feet west and 1,450 feet south of the northeast corner of sec. 18, T. 2 N., R. 3 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; mixed with a small amount of strong brown (7.5YR 5/6) silt loam; moderate fine and medium subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—10 to 20 inches; strong brown (7.5YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; common fine roots; medium discontinuous brown (7.5YR 5/4) clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—20 to 28 inches; strong brown (7.5YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; medium discontinuous dark brown (7.5YR 4/4) clay films and light yellowish brown (10YR 6/4) silt coatings on faces of peds; very strongly acid; gradual wavy boundary.

2Bt3—28 to 33 inches; strong brown (7.5YR 5/6) silty clay; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very firm; few fine roots; medium discontinuous pale brown (10YR 6/3) clay films on faces of peds; brown (10YR 5/3) slickensides; common very dark grayish brown (10YR 3/2) concretions; very strongly acid; gradual wavy boundary.

2Bt4—33 to 38 inches; strong brown (7.5YR 5/6) clay; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very firm; few fine roots; medium discontinuous pale brown (10YR 6/3) clay films on faces of peds; brown (10YR 5/3) slickensides; common very dark grayish brown (10YR 3/2) concretions; strongly acid; gradual wavy boundary.

2BC—38 to 48 inches; light olive brown (2.5Y 5/6) clay; weak medium angular blocky structure; very firm; light olive brown (2.5Y 5/4) slickensides; many very dark grayish brown (10YR 3/2) concretions; about 10 percent limestone fragments 3 to 10 inches in diameter; neutral; gradual wavy boundary.

2C—48 to 65 inches; light olive brown (2.5Y 5/6) very channery silty clay loam; common fine distinct light brownish gray (10YR 6/2) and few medium distinct brown (10YR 5/3) mottles; weak medium platy structure; very firm; many very dark grayish brown (10YR 3/2) concretions; about 30 percent channers and 10 percent flagstones; strong effervescence; mildly alkaline; gradual wavy boundary.

2Cr—65 inches; interbedded soft calcareous clayey shale and limestone flagstones.

The thickness of the solum ranges from 50 to 80 inches. The thickness of the loess ranges from 20 to 36 inches and the depth to interbedded limestone and calcareous shale from 60 to more than 80 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is strongly acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is silt loam or silty clay loam. It is strongly acid or medium acid. The 2Bt horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 4 to 8. It is silty clay or clay. It is very strongly acid to medium acid. The 2BC horizon is strongly acid to moderately alkaline. The 2C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 3 to 6. It is silty clay loam, silty clay, or clay in which the content of channers and flagstones ranges from 5 to 50 percent.

Weisburg Series

The Weisburg series consists of deep, well drained soils on glacial drift plains. These soils formed in loess and glacial drift and in the underlying clayey residuum. They have a fragipan. Permeability is moderate above the fragipan and very slow in and below the fragipan. Slopes range from 2 to 12 percent.

Weisburg soils are similar to Cincinnati soils. The similar soils formed in a thin mantle of loess and in the underlying glacial drift. They are on summits, shoulder slopes, and back slopes.

Typical pedon of Weisburg silt loam, 6 to 12 percent slopes, eroded, in a cultivated field; 300 feet north and 2,600 feet west of the southeast corner of sec. 11, T. 2 N., R. 2 W.

Ap—0 to 7 inches; dark yellowish brown (10YR 4/4) silt loam, pale brown (10YR 6/3) dry; mixed with a small amount of yellowish brown (10YR 5/6) silt loam; weak fine subangular blocky structure parting to weak medium granular; friable; common fine and medium roots; neutral; abrupt smooth boundary.

Bt1—7 to 17 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—17 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; common fine distinct light brownish gray (10YR 6/2) mottles in the lower part; weak medium prismatic structure parting to moderate medium angular blocky; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; many fine very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; strongly acid; gradual wavy boundary.

2Btx1—28 to 40 inches; strong brown (7.5YR 5/6) loam; common medium distinct grayish brown (10YR 5/2) mottles; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; thin discontinuous dark yellowish brown (10YR 4/4) and dark brown (7.5YR 4/4) clay films on faces of peds; many medium very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual wavy boundary.

2Btx2—40 to 56 inches; yellowish brown (10YR 5/6) clay loam; few medium distinct grayish brown (10YR 5/2) mottles; strong very coarse prismatic structure parting to moderate medium angular blocky; very firm; brittle; thin discontinuous dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) clay films on faces of peds; many medium very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; few till pebbles; very strongly acid; gradual wavy boundary.

3Bt—56 to 80 inches; yellowish brown (10YR 5/8) clay; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse angular blocky structure; very firm; thin discontinuous grayish brown (2.5Y 5/2) clay films on faces of peds; massive; very firm; few fine very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations; strongly acid.

The solum is more than 80 inches thick. The depth to the fragipan is 24 to 36 inches. The thickness of the loess ranges from 22 to 40 inches. The depth to clayey residuum ranges from 48 to 72 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It ranges from strongly acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is silt loam or silty clay loam. It is very strongly acid to slightly acid. The 2Btx horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, silt loam, silty clay loam, or clay loam. It is very strongly acid or strongly acid. The 3Bt horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 8. It is silty clay or clay. It is strongly acid or medium acid.

Wheeling Series

The Wheeling series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in stratified, silty or loamy material. Slopes range from 0 to 35 percent.

Wheeling soils are similar to Elkinsville soils and generally are adjacent to Huntington soils. Elkinsville soils have more silt and less sand in the lower part of the solum than the Wheeling soils. Huntington soils formed in silty recent alluvium on flood plains. They have a surface layer that is darker than that of the Wheeling soils.

Typical pedon of Wheeling loam, rarely flooded, 2 to 8 percent slopes, in a cultivated field; 1,500 feet north and 2,400 feet west of the southeast corner of sec. 7, T. 1 N., R. 2 W.

Ap—0 to 11 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; medium acid; clear smooth boundary.

Bt1—11 to 16 inches; strong brown (7.5YR 5/6) loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—16 to 58 inches; strong brown (7.5YR 4/6) loam; moderate medium subangular blocky structure; friable; few fine roots; medium discontinuous strong brown (7.5YR 4/6) clay films and pink (7.5YR 7/4) sand coatings on faces of peds; strongly acid; clear wavy boundary.

C—58 to 80 inches; yellowish brown (10YR 5/6) fine sandy loam; massive; very friable; strongly acid.

The solum ranges from 40 to 60 inches in thickness. It is strongly acid or medium acid.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam, silt loam, or fine sandy loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is fine sandy loam, silt loam, silty clay loam, loam, or sandy loam. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is stratified fine sandy loam to sand and gravel.

Wheeling loam, rarely flooded, 0 to 2 percent slopes, and Wheeling loam, rarely flooded, 18 to 35 percent slopes, are taxadjuncts to the Wheeling series because they classify as coarse-loamy rather than fine-loamy and have a wide range of texture in the subsoil. These differences, however, do not alter the usefulness or behavior of the soils.

Woolper Series

The Woolper series consists of deep, well drained, moderately slowly permeable soils on toe slopes and fans. These soils formed in colluvium or alluvium derived from soils that formed in limestone and shale residuum. Slopes range from 3 to 10 percent.

Woolper soils are similar to Pate soils and generally are adjacent to Eden soils. Pate and Eden soils formed in weathered material from interbedded limestone and calcareous shale. They have a surface layer that is lighter colored than that of the Woolper soils. Eden soils are moderately deep over bedrock.

Typical pedon of Woolper silty clay loam, 3 to 10 percent slopes, in a cultivated field; 650 feet west and

400 feet south of the northeast corner of sec. 21, T. 3 N., R. 12 E.

Ap—0 to 5 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; friable; many fine roots; neutral; clear smooth boundary.

Bt1—5 to 14 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; firm; common fine roots; thin discontinuous very dark grayish brown (10YR 3/2) clay films on faces of peds; neutral; clear smooth boundary.

Bt2—14 to 23 inches; dark brown (10YR 4/3) silty clay; strong medium subangular blocky structure; very firm; common fine roots; medium continuous dark brown (10YR 3/3) clay films on faces of peds; neutral; gradual wavy boundary.

Bt3—23 to 34 inches; dark yellowish brown (10YR 4/4) silty clay; strong medium angular and subangular blocky structure; very firm; few fine roots; medium continuous dark brown (10YR 3/3) clay films on faces of peds; about 10 percent channers; slight effervescence; mildly alkaline; gradual wavy boundary.

Bt4—34 to 43 inches; dark yellowish brown (10YR 4/4) silty clay; strong medium subangular blocky structure; very firm; few fine roots; medium continuous dark brown (10YR 3/3) clay films on faces of peds; about 3 percent channers; slight effervescence; mildly alkaline; gradual wavy boundary.

Bt5—43 to 57 inches; dark yellowish brown (10YR 4/4) silty clay; moderate medium subangular blocky structure; very firm; few fine roots; medium continuous dark brown (10YR 4/3) clay films on faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

C—57 to 60 inches; dark yellowish brown (10YR 4/4) silty clay; massive; very firm; neutral.

The thickness of the solum ranges from 40 to 60 inches. The depth to bedrock ranges from about 60 to more than 100 inches. Reaction is slightly acid to mildly alkaline throughout the profile.

The Ap horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3. It is silt loam or silty clay loam. The Bt1 horizon has colors similar to those of the Ap horizon. It is silty clay loam or silty clay. The Bt2, Bt3, Bt4, and Bt5 horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. They are silty clay or clay. The C horizon also is silty clay or clay. It has hue of 10YR, 7.5YR, or 2.5Y, value of 4 to 6, and chroma of 2 to 6.

Formation of the Soils

This section relates the major factors of soil formation to the soils in the county. It also describes the processes of soil formation.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always required for the differentiation of soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four.

Parent Material

Dr. Stanley M. Totten, professor of geology, Hanover College, helped prepare this section.

The soils in Switzerland County formed in widely diverse parent materials and on many different kinds of landscapes. Some formed in material weathered from limestone, dolomite, and shale bedrock (fig. 15). Some formed in unconsolidated sand, silt, and clay deposited by glaciers, streams, and wind (fig. 16). Parent materials, slope, and soil morphology are closely related. Thus, the presence of a particular soil is a good indication of the type of geologic material in which the soil formed. Mapping Switzerland County was difficult because the upper part of many soils formed in one kind of material and the lower part in another. The surficial material generally is only a few feet thick, and the bedrock is sufficiently close to the surface to have a strong influence on soil formation.

The bedrock exposed in Switzerland County belongs mostly to the Ordovician System of the Paleozoic Era. These rocks were probably deposited about 450 to 350 million years ago as fine grained sediments in shallow marine waters. The strata dip 20 to 25 feet per mile to the west, indicating that rock units are successively younger in that direction. Ordovician rocks occur in the hilly Dearborn Upland physiographic province throughout the county.

The Kope and Dillsboro Formations of the Ordovician System consist of fossiliferous, calcareous shale and thin limestone interbeds (fig. 17). Pate soils, which are on foot slopes, formed in material weathered from the Kope Formation. Eden, Carmel, and Switzerland soils, which are on summits, shoulder slopes, and back slopes, formed partly or entirely in material weathered from the more calcareous Dillsboro Formation. These slopes are easily eroded in the valleys of the Ohio River and of the major creeks and their tributaries. Saluda Dolomite underlies loess and glacial drift deposits at the higher elevations in the northwestern part of the county. In these areas Carmel, Switzerland, Weisburg, Cincinnati, and Rossmoyne soils formed in various combinations of loess, drift, and dolomite residuum.

Switzerland County was covered by continental ice sheets two or three different times in the last 1 million years. These glaciers diverted the drainage of southeastern Indiana across the divide at Madison, forming the Ohio River. They left deposits of drift and outwash, which are important parent materials.

Illinoian drift, ranging in thickness from a few feet on some of the uplands in the central part of the county to 30 feet or more in some areas in the valley of the Ohio River, is the parent material of many upland soils. About 2 to 4 feet of Peorian loess, which is windblown silty material derived primarily from the flood plain of the Ohio River and other major rivers, caps the drift. The lower part of the loess has more sand than the upper part and probably was derived from local sources during the retreat of Illinoian ice. The upper part of the loess is silty and may have been derived from more distant sources during the Wisconsinan Glaciation. Both loess deposits contain an appreciable amount of clay. A fragipan has formed at the boundary between the two kinds of loess in many areas.

The drift and loess together are the parent material of Cincinnati, Rossmoyne, Avonburg, Cobbsfork, and

System	Formation-Member	Thickness (feet)	Description	Soil Series
ORDOVICIAN	Saluda	60	Massive gray to tan dolomite	Soil inclusions
	Dillsboro	300	Soft bluish-gray shale: 30% thin fossiliferous limestone interbeds	Eden Carmel Switzerland Weisburg Woolper
	Kope	20	Soft gray shale: 10% limestone interbeds	Pate

Figure 15.—The relationship of some soils in Switzerland County to consolidated bedrock.

Bonnell soils. Avonburg and Cobbsfork soils are on tabular divides. Cincinnati, Rossmoyne, and Bonnell soils are on summits, shoulder slopes, and back slopes. The Illinoian drift and loess formerly were the surface material throughout the county, but erosion has removed nearly all of this material from valley bottoms and from hillsides in the eastern part of the county.

The Wisconsinan ice advance did not reach as far south as Switzerland County, but the meltwater from this last ice advance deposited large volumes of sand and gravel outwash in the valley of the Ohio River. Terrace gravel underlies silty and loamy alluvium, which is the parent material of Elkinsville, Pekin, and Wheeling soils.

Deposition of the gravel raised the terrace level above the level of the tributaries of the Ohio River, thereby damming the tributary streams and forming temporary lakes. Markland soils formed partly in the resulting clayey and silty lacustrine material, which is preserved on terraces in the valleys of the major creeks.

After the last of the ice sheets melted, about 20,000 years ago, rivers and streams modified the landscape slightly, causing the development of new flood plains. These modern flood plains contain alluvial deposits of clay, silt, sand, gravel, and cobbles. Loamy and silty alluvium along the major creeks is the parent material of Chagrin soils. Huntington soils formed in the organic-rich silty alluvium on the flood plains along the Ohio River and the lower reaches of the major creeks. Dearborn soils formed in channery and flaggy alluvium in narrow valleys and on toe slopes and fans near the base of steep hillsides throughout the county.

Plant and Animal Life

Plants have been the principal organisms influencing the soils in Switzerland County. Bacteria, fungi, and earthworms, however, have also been important. The chief contribution of plant and animal life to soil formation is the addition of organic matter and nitrogen

Geologic Series	Stage	Description	Thickness (feet)	Soil Series
Holocene	Recent	Organic-rich silty alluvium	0-15	Huntington
		Loamy alluvium	0-5	Chagrin
		Channery alluvium	0-5	Dearborn
		Silty alluvium	0-10	Elkinsville Pekin Newark
		Wind deposited sands	0-10	Bloomfield
Pleisto-cene	Wis-con-sinan	Silty and loamy alluvium over terrace gravel	0-100	Wheeling
		Lake clay and silt	0-30	Markland
	Illi-noian	Drift and Loess	0-25	Cincinnati Rossmoyne Avonburg Cobbsfork Weisburg Bonnell

Figure 16.—The relationship of some soils in Switzerland County to unconsolidated parent material.

to the soil. The kind of organic material in the soil depends on the kinds of plants that grew on the soil in the past. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter. The roots of the plants provided channels for the downward movement of water through the soil and added organic matter as they decayed. Bacteria helped to break down the organic matter into plant nutrients.

The native vegetation in Switzerland County was mainly deciduous trees. Differences in natural soil drainage and minor variations in the parent material affected the composition of the forest species. The well

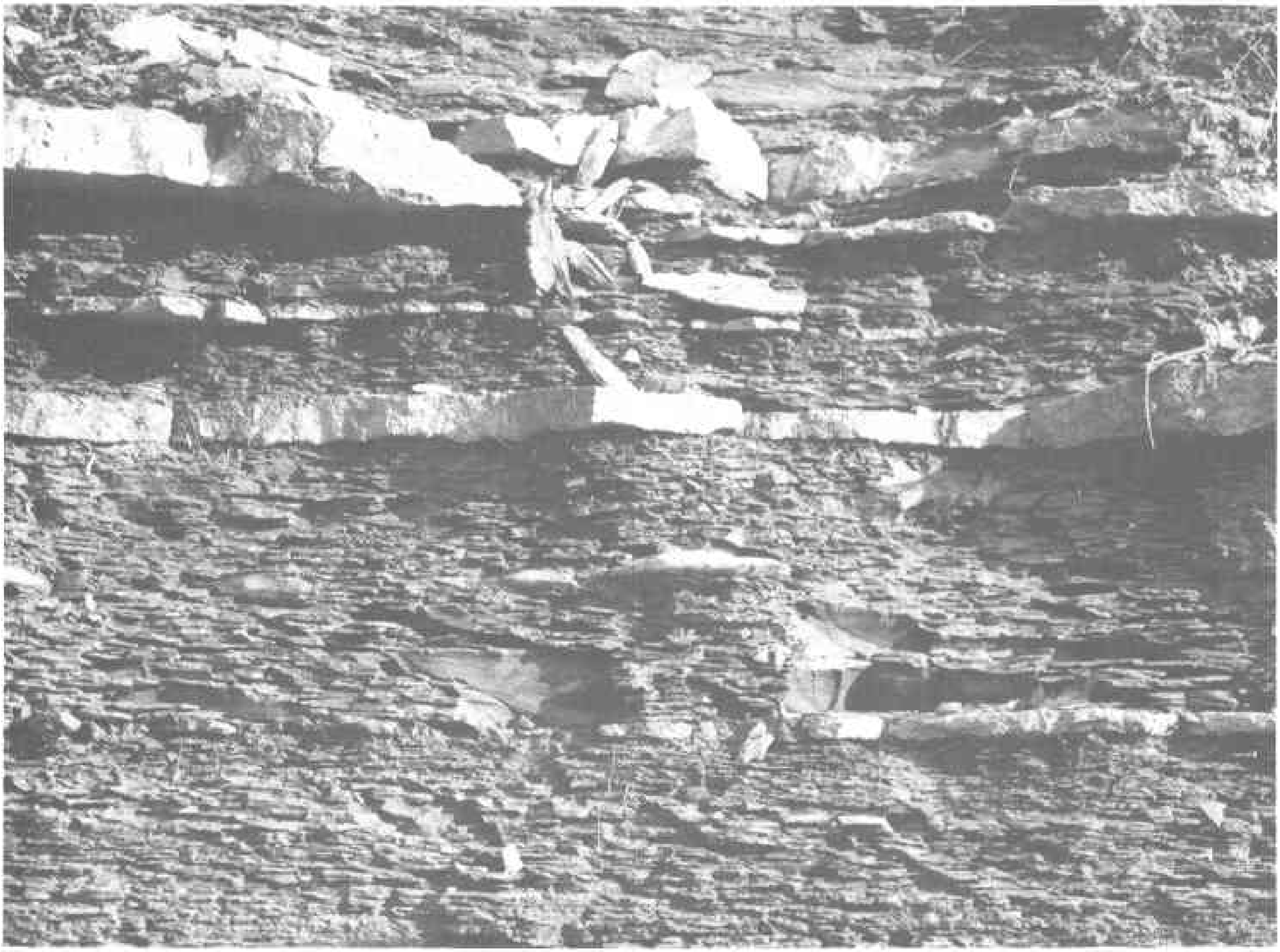

Figure 17.—Exposure of interbedded limestone and calcareous shale of the Kope Formation. The interbeds of limestone in the upper part range from 3 to 8 inches in thickness.

drained upland soils, such as Eden and Cincinnati soils, were covered mainly by sugar maple, hickory, white oak, and red oak. The wet soils, such as Cobbsfork and Avonburg soils, supported mainly beech, sweetgum, blackgum, and pin oak.

Climate

Climate helps to determine the kind of plant and animal life on and in the soil, the amount of water available for the weathering of minerals and the translocation of soil material, and the rate of chemical reaction in the soil.

The climate in Switzerland County is cool and humid. It is presumably similar to the climate under which the soils formed. The soils in this county differ from those that formed under a dry, warm climate and from those that formed under a hot, moist climate. Climate is uniform throughout the county, although its effect is modified locally by runoff. Only minor differences among the soils are the result of differences in climate. More information about the climate is available under the heading "General Nature of the County."

Relief

Relief has markedly affected the soils in Switzerland County through its effect on natural drainage, runoff, erosion, plant cover, and soil temperature. Slopes range from 0 to 50 percent. Runoff is most rapid on the steeper slopes. Water is temporarily ponded in low areas.

The soils in the county are somewhat excessively drained to poorly drained. Through its effect on aeration in the soil, drainage determines the color of the soil. Water and air move freely through well drained soils and slowly through poorly drained soils. In Wheeling and other well drained, well aerated soils, the iron compounds that give most soils their color are brightly colored and oxidized. Cobbsfork and other poorly aerated, poorly drained soils are dull gray and mottled.

Time

Usually, a long time is needed for the processes of soil formation to form distinct horizons in the parent material. Differences in the length of time that the parent material has been in place are commonly reflected in degree of profile development. Some soils form rapidly. Others form slowly.

The soils in Switzerland County range from young to mature. The glacial deposits in which many of the soils formed have been exposed to the soil-forming factors long enough for distinct horizons to form. Some soils, however, have not been in place long enough for the development of distinct horizons. Chagrin and other young soils that formed in recent alluvial material are examples.

Markland and Cincinnati soils show the effect of time on leaching of lime from the solum. The parent material of these soils had about the same amount of lime as is currently in the substratum. Markland soils were submerged under glacial lake water and thus were protected from leaching. In contrast, Cincinnati soils were above water and were subject to leaching. The difference in the length of time that the soils have been subject to leaching is reflected in the depth to lime. Cincinnati soils are leached of lime to a depth of 48 to 100 inches. On the other hand, Markland soils are leached to a depth of 20 to 40 inches.

Processes of Soil Formation

Several processes have been involved in the formation of the soils in Switzerland County. These processes are the accumulation of organic matter; the dissolution, transfer, and removal of calcium carbonates and bases; the liberation and translocation of silicate clay minerals; and the reduction and transfer of iron. In most soils more than one of these processes have helped to differentiate horizons.

Some organic matter has accumulated in the surface layer of all the soils in the county. The organic matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, such as Dearborn and Huntington soils, have a thick, dark surface layer.

Carbonates and bases have been leached from the upper horizons of nearly all the soils in the county. Leaching probably preceded the translocation of silicate clay minerals. Nearly all of the carbonates and some of the bases have been leached from the A and B horizons of well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because of a high water table or the slow movement of water through the profile.

Clay accumulates in pores and other voids and forms clay films on the surfaces along which water moves. The leaching of bases and the translocation of silicate clay minerals are among the more important processes of horizon differentiation in the county. Switzerland soils are an example of soils in which translocated silicate clay minerals have accumulated in the form of clay films in the Bt and 2Bt horizons.

Gleying, or the reduction and transfer of iron, has occurred in the poorly drained and somewhat poorly drained soils in the county. In the naturally wet soils, this process has significantly affected horizon differentiation. Reduction is commonly accompanied by some transfer of iron, either from upper horizons to lower ones or completely out of the profile. Mottles, which are in some horizons, indicate the segregation of iron. A grayish color in the subsoil indicates the presence of reduced iron compounds or the loss of iron from the horizon.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The linear and middle part of a hill slope.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The concave part of a hill slope that links the linear segments of the landscape to the lower terrain and is in part erosional and in part depositional.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hill slope. The land between a stream or valley and highland.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The convex, rounded land between a summit and a back slope.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. Narrow, nearly level to moderately sloping highland between two minor drainageways.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Tabular divide. Broad, nearly level highland between two major drainageways.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. An extension of the base of a hill slope or a narrow valley, either of which is covered with alluvium or colluvium, or both.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Madison, Indiana]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	42.0	24.0	33.1	67	-3	33	3.21	1.80	4.36	7	5.4
February---	46.7	26.7	36.7	69	1	74	3.34	1.52	4.82	7	2.3
March------	55.4	33.7	44.5	80	14	231	4.48	2.48	6.10	9	2.9
April------	68.4	43.5	55.8	86	25	474	4.03	2.02	5.66	9	.1
May--------	77.5	52.8	65.2	93	33	781	4.48	2.59	6.01	8	.0
June-------	85.3	62.2	73.8	97	45	1,014	4.01	2.36	5.46	7	.0
July-------	88.1	65.9	77.0	98	51	1,147	3.76	2.18	5.03	7	.0
August-----	87.3	64.2	75.8	98	50	1,110	2.61	1.18	3.78	5	.0
September--	82.3	57.9	70.1	97	40	903	3.15	1.49	4.49	6	.0
October----	71.4	46.5	59.0	88	27	589	2.60	1.27	3.68	5	.0
November---	56.3	36.5	46.4	79	14	216	3.25	1.78	4.44	6	.6
December---	44.7	26.8	35.7	70	2	75	3.05	1.54	4.29	6	1.8
Yearly:											
Average--	67.1	45.1	56.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	102	-5	---	---	---	---	---	---
Total----	---	---	---	---	---	6,647	41.97	35.46	48.16	82	13.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Madison, Indiana]

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 7	Apr. 18	Apr. 30
2 years in 10 later than--	Apr. 2	Apr. 14	Apr. 25
5 years in 10 later than--	Mar. 23	Apr. 5	Apr. 16
First freezing temperature in fall:			
1 year in 10 earlier than--	Nov. 1	Oct. 21	Oct. 7
2 years in 10 earlier than--	Nov. 6	Oct. 26	Oct. 12
5 years in 10 earlier than--	Nov. 17	Nov. 4	Oct. 23

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Madison, Indiana]

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	220	192	172
8 years in 10	226	199	178
5 years in 10	239	213	189
2 years in 10	252	227	201
1 year in 10	258	234	207

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AvA	Avonburg silt loam, 0 to 2 percent slopes	4,050	2.8
AvB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	330	0.2
BmC	Bloomfield loamy fine sand, 4 to 12 percent slopes	240	0.2
BoC2	Bonnell silty clay loam, 6 to 12 percent slopes, eroded	1,800	1.3
BoE2	Bonnell silty clay loam, 15 to 25 percent slopes, eroded	5,300	3.7
CaC2	Carmel silty clay loam, 6 to 12 percent slopes, eroded	4,100	2.9
CaC3	Carmel silty clay loam, 6 to 12 percent slopes, severely eroded	275	0.2
Ch	Chagrin silt loam, occasionally flooded	1,400	1.0
CnB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded	7,600	5.3
CnC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	5,600	3.9
CnC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded	560	0.4
Co	Cobbsfork silt loam	2,800	2.0
Dn	Dearborn loam, frequently flooded	595	0.4
Dr	Dearborn channery silt loam, frequently flooded	1,000	0.7
EdF2	Eden flaggy silt loam, 25 to 50 percent slopes, eroded	35,750	25.0
EeE2	Eden silty clay loam, 15 to 50 percent slopes, eroded	24,250	16.9
EkA	Elkinsville silt loam, rarely flooded, 0 to 2 percent slopes	820	0.6
EkB	Elkinsville silt loam, rarely flooded, 2 to 8 percent slopes	410	0.3
Hu	Huntington silt loam, occasionally flooded	3,800	2.7
MaB2	Markland silt loam, 1 to 6 percent slopes, eroded	220	0.2
MaC2	Markland silt loam, 8 to 15 percent slopes, eroded	700	0.5
Ne	Newark silt loam, occasionally flooded	350	0.2
PaE2	Pate silt loam, 15 to 25 percent slopes, eroded	2,500	1.7
PkB	Pekin silt loam, rarely flooded, 1 to 4 percent slopes	380	0.3
RoA	Rossmoyne silt loam, 0 to 2 percent slopes	2,600	1.8
RoB2	Rossmoyne silt loam, 2 to 6 percent slopes, eroded	2,500	1.7
SwB2	Switzerland silt loam, 2 to 6 percent slopes, eroded	620	0.4
SwC2	Switzerland silt loam, 6 to 12 percent slopes, eroded	15,000	10.5
Ud	Udorthents, loamy	430	0.3
WgB2	Weisburg silt loam, 2 to 6 percent slopes, eroded	2,250	1.6
WgC2	Weisburg silt loam, 6 to 12 percent slopes, eroded	10,600	7.4
WhA	Wheeling loam, rarely flooded, 0 to 2 percent slopes	890	0.6
WhB	Wheeling loam, rarely flooded, 2 to 8 percent slopes	1,500	1.1
WhC	Wheeling loam, rarely flooded, 8 to 15 percent slopes	450	0.3
WhE	Wheeling loam, rarely flooded, 18 to 35 percent slopes	500	0.3
WvC	Woolper silty clay loam, 3 to 10 percent slopes	319	0.2
	Water areas more than 40 acres in size	115	0.1
	Water areas less than 40 acres in size	500	0.3
	Total	143,104	100.0

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
AvA	Avonburg silt loam, 0 to 2 percent slopes (where drained)
AvB2	Avonburg silt loam, 2 to 4 percent slopes, eroded (where drained)
Ch	Chagrin silt loam, occasionally flooded
CnB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded
Co	Cobbsfork silt loam (where drained)
EkA	Elkinsville silt loam, rarely flooded, 0 to 2 percent slopes
EkB	Elkinsville silt loam, rarely flooded, 2 to 8 percent slopes
Hu	Huntington silt loam, occasionally flooded
MaB2	Markland silt loam, 1 to 6 percent slopes, eroded
Ne	Newark silt loam, occasionally flooded (where drained)
PkB	Pekin silt loam, rarely flooded, 1 to 4 percent slopes
RoA	Rossmoyne silt loam, 0 to 2 percent slopes
RoB2	Rossmoyne silt loam, 2 to 6 percent slopes, eroded
SwB2	Switzerland silt loam, 2 to 6 percent slopes, eroded
WgB2	Weisburg silt loam, 2 to 6 percent slopes, eroded
WhA	Wheeling loam, rarely flooded, 0 to 2 percent slopes
WhB	Wheeling loam, rarely flooded, 2 to 8 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-red clover hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
AvA: Avonburg	IIw	110	38	50	3.6	7.2
AvB2: Avonburg	IIe	100	35	45	3.3	6.6
BmC: Bloomfield	IIIe	75	29	39	3.0	6.0
BoC2: Bonnell	IIIe	90	27	32	3.4	7.0
BoE2: Bonnell	VIe	---	---	---	---	---
CaC2: Carmel	IIIe	90	28	36	2.6	5.2
CaC3: Carmel	IVe	80	24	32	2.3	4.6
Ch: Chagrin	IIw	125	40	45	4.5	9.0
CnB2: Cincinnati	IIe	105	30	45	---	---
CnC2: Cincinnati	IIIe	100	30	40	---	---
CnC3: Cincinnati	IVe	90	20	35	---	---
Co: Cobbsfork	IIIw	110	35	35	3.6	7.2
Dn: Dearborn	IIIs	90	38	40	3.0	6.0
Dr: Dearborn	IIIs	70	25	30	2.8	5.6
EdF2: Eden	VIIe	---	---	---	---	---
EeE2: Eden	VIe	---	---	---	---	---
EkA: Elkinsville	I	120	42	48	4.0	8.0
EkB: Elkinsville	IIe	120	42	48	4.0	8.0
Hu: Huntington	IIw	130	45	---	3.5	7.0
MaB2: Markland	IIIe	80	28	36	2.6	5.2

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-red clover hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
MaC2----------------------- Markland	IVe	75	26	34	2.5	5.0
Ne------------------------- Newark	IIw	110	40	---	4.5	9.0
PaE2----------------------- Pate	VIe	---	---	22	1.6	3.2
PkB------------------------ Pekin	IIe	105	37	47	3.4	6.8
RoA------------------------ Rossmoyne	IIw	110	35	40	4.5	9.0
RoB2----------------------- Rossmoyne	IIe	100	30	35	4.0	8.0
SwB2----------------------- Switzerland	IIe	90	32	40	3.0	6.0
SwC2----------------------- Switzerland	IIIe	80	28	36	2.6	5.2
Ud------------------------- Udorthents	VIe	---	---	---	---	---
WgB2----------------------- Weisburg	IIe	105	30	45	4.5	5.0
WgC2----------------------- Weisburg	IIIe	100	30	40	4.5	5.0
WhA------------------------ Wheeling	I	125	40	---	---	---
WhB------------------------ Wheeling	IIe	125	40	---	---	---
WhC------------------------ Wheeling	IIIe	115	35	---	---	---
WhE------------------------ Wheeling	VIe	---	---	---	---	---
WvC------------------------ Woolper	IIIe	110	35	---	3.5	7.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	1,710	---	---	---	---
II	27,790	15,590	12,200	---	---
III	42,724	38,329	2,800	1,595	---
IV	1,535	1,535	---	---	---
V	---	---	---	---	---
VI	32,550	32,550	---	---	---
VII	35,750	35,750	---	---	---
VIII	---	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
AvA, AvB2 Avonburg	4D	Slight	Slight	Moderate	Moderate	White oak	70	52	Eastern white pine, baldcypress, white ash, red maple, yellow-poplar, American sycamore.
						Northern red oak	75	57	
						Pin oak	85	67	
						Yellow-poplar	85	81	
						Sweetgum	80	79	
BmC Bloomfield	4S	Slight	Slight	Moderate	Slight	Black oak	70	52	Eastern white pine, red pine.
						White oak	---	---	
						Scarlet oak	---	---	
						Shagbark hickory	---	---	
BoC2 Bonnell	4C	Slight	Moderate	Slight	Slight	Northern red oak	76	58	Yellow-poplar, eastern white pine, shortleaf pine, Virginia pine.
						Yellow-poplar	90	90	
						Shortleaf pine	80	130	
						Virginia pine	80	122	
BoE2 Bonnell	4R	Moderate	Severe	Slight	Slight	Northern red oak	76	58	Yellow-poplar, eastern white pine, shortleaf pine, Virginia pine, loblolly pine.
						Yellow-poplar	90	90	
						Shortleaf pine	80	130	
						Virginia pine	80	122	
CaC2 Carmel	5C	Slight	Slight	Severe	Severe	Northern red oak	86	68	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
						Yellow-poplar	98	104	
						Virginia pine	---	---	
						Shortleaf pine	---	---	
						Eastern white pine	---	---	
						Sweetgum	---	---	
CaC3 Carmel	4C	Slight	Moderate	Severe	Severe	Northern red oak	80	62	Eastern white pine, red pine, Virginia pine, black walnut, yellow-poplar.
						White oak	---	---	
						Yellow-poplar	90	90	
						White ash	---	---	
Ch Chagrin	5A	Slight	Slight	Slight	Slight	Northern red oak	86	68	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
						Yellow-poplar	96	100	
						Sugar maple	86	54	
						White oak	---	---	
						Black cherry	---	---	
						White ash	---	---	
						Black walnut	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
CnB2, CnC2, CnC3: Cincinnati	4A	Slight	Slight	Slight	Slight	Northern red oak	80	62	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
						White oak	---	---	
						Black walnut	---	---	
						Black cherry	---	---	
						Sugar maple	---	---	
						White ash	---	---	
						Yellow-poplar	---	---	
Co: Cobbsfork	6W	Slight	Severe	Moderate	Moderate	Pin oak	100	82	American sycamore, eastern cottonwood, green ash, pin oak, red maple, silver maple, swamp white oak, sweetgum.
						Yellow-poplar	---	---	
						American beech	---	---	
						Red maple	---	---	
						Sweetgum	---	---	
Dn, Dr: Dearborn	6A	Slight	Slight	Slight	Slight	Yellow-poplar	90	90	Black walnut, eastern cottonwood, white oak, yellow-poplar, white ash, eastern white pine.
						Sweetgum	---	---	
						White ash	---	---	
						Green ash	---	---	
						White oak	---	---	
						Red maple	---	---	
						Hickory	---	---	
EdF2: Eden	4R	Severe	Severe	Moderate	Moderate	Black oak	68	50	Northern red oak, white oak, white ash, eastern white pine, Virginia pine.
						White oak	61	44	
						White ash	60	51	
						Scarlet oak	68	50	
						Black walnut	74	---	
						Eastern redcedar	42	---	
EeE2: Eden	4R	Moderate	Moderate	Severe	Moderate	Eastern redcedar	35	---	Virginia pine.
						Black oak	---	---	
						White oak	---	---	
						Scarlet oak	---	---	
EkA, EkB: Elkinsville	5A	Slight	Slight	Slight	Slight	White oak	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar	98	104	
						Sweetgum	76	70	
Hu: Huntington	7A	Slight	Slight	Slight	Slight	Yellow-poplar	95	98	Yellow-poplar, black walnut, eastern white pine.
						Northern red oak	85	67	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
MaB2, MaC2------ Markland	4C	Slight	Slight	Severe	Severe	White oak-----------	75	57	Eastern white pine, red pine, yellow-poplar, white ash.
						Northern red oak----	78	60	
Ne-------------- Newark	5W	Slight	Moderate	Slight	Moderate	Pin oak-------------	96	78	Eastern cottonwood, sweetgum, American sycamore.
						Eastern cottonwood--	89	---	
						Sweetgum------------	85	93	
						Green ash-----------	---	---	
						Cherrybark oak------	---	---	
						Shumard oak---------	---	---	
						Overcup oak---------	---	---	
PaE2------------ Pate	5R	Moderate	Moderate	Severe	Severe	Northern red oak----	86	68	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
						Yellow-poplar-------	98	104	
						Virginia pine-------	---	---	
						White oak-----------	---	---	
						Sweetgum------------	---	---	
PkB------------- Pekin	4A	Slight	Slight	Slight	Slight	White oak-----------	70	52	Eastern white pine, red pine, yellow-poplar, white ash.
						Yellow-poplar-------	85	81	
						Virginia pine-------	75	115	
						Sugar maple---------	75	47	
RoA, RoB2------- Rossmoyne	3D	Slight	Slight	Moderate	Moderate	White oak-----------	61	44	White ash, Virginia pine, yellow-poplar, eastern white pine, black oak.
						White ash-----------	---	---	
						Northern red oak----	80	62	
						Sugar maple---------	---	---	
						Slippery elm--------	---	---	
						American beech------	---	---	
						American sycamore---	---	---	
SwB2, SwC2------ Switzerland	5A	Slight	Slight	Slight	Slight	Northern red oak----	86	68	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
						Yellow-poplar-------	98	104	
						Virginia pine-------	---	---	
						Shortleaf pine------	---	---	
						White oak-----------	---	---	
						Sweetgum------------	---	---	
WgB2, WgC2------ Weisburg	4A	Slight	Slight	Slight	Slight	Northern red oak----	80	62	Eastern white pine, black walnut, yellow-poplar.
WhA, WhB, WhC--- Wheeling	4A	Slight	Slight	Slight	Slight	Northern red oak----	80	62	Eastern white pine, yellow-poplar, black walnut.
						Yellow-poplar-------	90	90	
WhE------------- Wheeling	4R	Moderate	Moderate	Slight	Slight	Northern red oak----	80	62	Eastern white pine, yellow-poplar, black walnut.
						Yellow-poplar-------	90	90	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
WvC------------- Woolper	4C	Slight	Moderate	Moderate	Slight	Black oak----------- Chinkapin oak------- White ash----------- Hickory------------- Sugar maple--------- White oak----------- Yellow buckeye------ Black walnut--------	75 71 --- --- --- --- --- ---	57 53 --- --- --- --- --- ---	Yellow-poplar, white ash, white oak, northern red oak, eastern white pine.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
AvA, AvB2: Avonburg	---	Arrowwood, eastern redcedar, Washington hawthorn, Amur honeysuckle, American cranberrybush, Amur privet, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
BmC: Bloomfield	Siberian peashrub	Radiant crabapple, eastern redcedar, autumn-olive, Washington hawthorn, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
BoC2, BoE2: Bonnell	---	Eastern redcedar, Washington hawthorn, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Pin oak, eastern white pine.	---
CaC2, CaC3: Carmel	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
Ch: Chagrin	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine.
CnB2, CnC2, CnC3: Cincinnati	---	Eastern redcedar, Washington hawthorn, Tatarian honeysuckle, Amur privet, Amur honeysuckle, arrowwood, American cranberrybush.	Green ash, Austrian pine, osageorange.	Pin oak, eastern white pine.	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Co: Cobbsfork	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.
Dn, Dr: Dearborn	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine.
EdF2, EeE2: Eden	---	American cranberrybush, Amur honeysuckle, Tatarian honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Hackberry, osageorange, Austrian pine.	Eastern white pine.	---
EkA, EkB: Elkinsville	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
Hu: Huntington	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, blue spruce, northern white-cedar, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
MaB2, MaC2: Markland	---	Arrowwood, Washington hawthorn, eastern redcedar, Amur honeysuckle, American cranberrybush, Tatarian honeysuckle, Amur privet.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
Ne: Newark	Redosier dogwood	Silky dogwood, American cranberrybush, American plum.	Washington hawthorn, Austrian pine, hackberry.	Golden willow, Norway spruce, honeylocust.	Pin oak, eastern cottonwood.
PaE2: Pate	---	Eastern redcedar, Washington hawthorn, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Pin oak, eastern white pine.	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
PkB Pekin	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
RoA, RoB2 Rossmoyne	---	Washington hawthorn, Amur honeysuckle, Amur privet, Tatarian honeysuckle, eastern redcedar, arrowwood, American cranberrybush.	Austrian pine, osageorange, green ash.	Pin oak, eastern white pine.	---
SwB2, SwC2 Switzerland	---	Eastern redcedar, Washington hawthorn, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Pin oak, eastern white pine.	---
Ud. Udorthents					
WgB2, WgC2 Weisburg	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
WhA, WhB, WhC, WhE Wheeling	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, blue spruce, northern white-cedar, white fir.	Norway spruce	Austrian pine, pin oak, eastern white pine.
WvC Woolper	---	American cranberrybush, Amur honeysuckle, Tatarian honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Hackberry, osageorange, Austrian pine.	Pin oak, eastern white pine.	---

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AvA, AvB2 Avonburg	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
BmC Bloomfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
BoC2 Bonnell	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
BoE2 Bonnell	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
CaC2, CaC3 Carmel	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope.
Ch Chagrin	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
CnB2 Cincinnati	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
CnC2, CnC3 Cincinnati	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Co Cobbsfork	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Dn, Dr Dearborn	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
EdF2 Eden	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, slope.
EeE2 Eden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
EkA Elkinsville	Severe: flooding.	Slight	Slight	Slight	Slight.
EkB Elkinsville	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
Hu Huntington	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
MaB2 Markland	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MaC2: Markland	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Ne: Newark	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
PaE2: Pate	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
PkB: Pekin	Severe: flooding, percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
RoA: Rossmoyne	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
RoB2: Rossmoyne	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
SwB2: Switzerland	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
SwC2: Switzerland	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope.
Ud. Udorthents					
WgB2: Weisburg	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
WgC2: Weisburg	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope.
WhA: Wheeling	Severe: flooding.	Slight	Slight	Slight	Slight.
WhB: Wheeling	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
WhC: Wheeling	Severe: flooding.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
WhE: Wheeling	Severe: flooding, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
WvC: Woolper	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AvA----------------- Avonburg	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
AvB2---------------- Avonburg	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BmC----------------- Bloomfield	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
BoC2---------------- Bonnell	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
BoE2---------------- Bonnell	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
CaC2, CaC3---------- Carmel	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ch------------------ Chagrin	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CnB2---------------- Cincinnati	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CnC2, CnC3---------- Cincinnati	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Co------------------ Cobbsfork	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Dn, Dr-------------- Dearborn	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
EdF2---------------- Eden	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
EeE2---------------- Eden	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
EkA, EkB------------ Elkinsville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Hu------------------ Huntington	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MaB2---------------- Markland	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MaC2---------------- Markland	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ne------------------ Newark	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
PaE2---------------- Pate	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
PkB----------------- Pekin	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RoA----------------- Rossmoyne	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
RoB2---------------- Rossmoyne	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
SwB2---------------- Switzerland	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
SwC2---------------- Switzerland	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ud. Udorthents										
WgB2---------------- Weisburg	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WgC2---------------- Weisburg	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WhA----------------- Wheeling	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WhB----------------- Wheeling	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WhC----------------- Wheeling	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WhE----------------- Wheeling	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
WvC----------------- Woolper	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AvA, AvB2 Avonburg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
BmC Bloomfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
BoC2 Bonnell	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
BoE2 Bonnell	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
CaC2, CaC3 Carmel	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
Ch Chagrin	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
CnB2 Cincinnati	Moderate: dense layer, wetness.	Slight	Moderate: wetness.	Moderate: slope.	Severe: low strength, frost action.	Slight.
CnC2, CnC3 Cincinnati	Moderate: dense layer, wetness, slope.	Moderate: slope.	Moderate: wetness, slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Co Cobbsfork	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
Dn Dearborn	Moderate: large stones, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Dr Dearborn	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
EdF2 Eden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: large stones, slope.
EeE2 Eden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
EkA, EkB Elkinsville	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
Hu Huntington	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MaB2: Markland	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
MaC2: Markland	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
Ne: Newark	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
PaE2: Pate	Severe: slope.	Severe: shrink-swell, slope, slippage.	Severe: slope, shrink-swell, slippage.	Severe: shrink-swell, slope, slippage.	Severe: slippage, slope, shrink-swell.	Severe: slope.
PkB: Pekin	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
RoA: Rossmoyne	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
RoB2: Rossmoyne	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
SwB2: Switzerland	Moderate: too clayey.	Moderate: shrink-swell.	Severe: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
SwC2: Switzerland	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Severe: shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Ud. Udorthents						
WgB2: Weisburg	Moderate: too clayey.	Moderate: shrink-swell.	Severe: shrink-swell.	Moderate: shrink-swell, slope.	Severe: frost action.	Slight.
WgC2: Weisburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Severe: shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
WhA, WhB: Wheeling	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action, low strength.	Slight.
WhC: Wheeling	Moderate: slope.	Severe: flooding.	Severe: flooding.	Severe: flooding, slope.	Moderate: slope, flooding, frost action.	Moderate: slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WhE--------------- Wheeling	Severe: slope.	Severe: flooding, slope.	Severe: flooding, slope.	Severe: flooding, slope.	Severe: slope.	Severe: slope.
WvC--------------- Woolper	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AvA: Avonburg	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
AvB2: Avonburg	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
BmC: Bloomfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
BoC2: Bonnell	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
BoE2: Bonnell	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: too clayey, hard to pack, slope.
CaC2, CaC3: Carmel	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
Ch: Chagrin	Severe: flooding.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
CnB2: Cincinnati	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
CnC2, CnC3: Cincinnati	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
Co: Cobbsfork	Severe: ponding, percs slowly.	Slight	Severe: ponding.	Severe: ponding.	Poor: ponding.
Dn: Dearborn	Severe: flooding.	Severe: flooding.	Severe: flooding, large stones.	Severe: flooding.	Poor: large stones.
Dr: Dearborn	Severe: flooding.	Severe: seepage, flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Poor: small stones.
EdF2: Eden	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, slope.
EeE2: Eden	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
EkA: Elkinsville	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
EkB: Elkinsville	Moderate: flooding.	Moderate: seepage, slope.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Hu: Huntington	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
MaB2: Markland	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
MaC2: Markland	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Ne: Newark	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
PaE2: Pate	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
PkB: Pekin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
RoA: Rossmoyne	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
RoB2: Rossmoyne	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
SwB2: Switzerland	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
SwC2: Switzerland	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Ud. Udorthents					
WgB2: Weisburg	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Poor: too clayey, hard to pack.
WgC2: Weisburg	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
WhA, WhB: Wheeling	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Moderate: flooding.	Fair: thin layer.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
WhC: Wheeling	Severe: poor filter.	Severe: slope, seepage.	Severe: seepage.	Moderate: slope, flooding.	Fair: slope, thin layer.
WhE: Wheeling	Severe: poor filter, slope.	Severe: slope, seepage.	Severe: slope, seepage.	Severe: slope.	Poor: slope.
WvC: Woolper	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AvA, AvB2 Avonburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
BmC Bloomfield	Good	Probable	Improbable: too sandy.	Fair: too sandy, slope.
BoC2 Bonnell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
BoE2 Bonnell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
CaC2, CaC3 Carmel	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
Ch Chagrin	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
CnB2 Cincinnati	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
CnC2, CnC3 Cincinnati	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, slope.
Co Cobbsfork	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Dn, Dr Dearborn	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
EdF2 Eden	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, too clayey.
EeE2 Eden	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
EkA, EkB Elkinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Hu Huntington	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
MaB2, MaC2 Markland	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ne-------------------- Newark	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
PaE2------------------ Pate	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
PkB------------------- Pekin	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
RoA, RoB2------------- Rossmoyne	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
SwB2------------------ Switzerland	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
SwC2------------------ Switzerland	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Ud. Udorthents				
WgB2------------------ Weisburg	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
WgC2------------------ Weisburg	Poor: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
WhA, WhB-------------- Wheeling	Fair: low strength.	Probable-------------	Probable-------------	Fair: small stones.
WhC------------------- Wheeling	Fair: low strength.	Probable-------------	Probable-------------	Fair: small stones, slope.
WhE------------------- Wheeling	Poor: slope.	Probable-------------	Probable-------------	Poor: slope.
WvC------------------- Woolper	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
AvA: Avonburg	Slight	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness, rooting depth.	Wetness, erodes easily, rooting depth.
AvB2: Avonburg	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness, rooting depth.	Wetness, erodes easily, rooting depth.
BmC: Bloomfield	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
BoC2, BoE2: Bonnell	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
CaC2, CaC3: Carmel	Severe: slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, rooting depth.
Ch: Chagrin	Moderate: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Favorable	Favorable.
CnB2: Cincinnati	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.
CnC2, CnC3: Cincinnati	Severe: slope.	Severe: thin layer.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
Co: Cobbsfork	Slight	Severe: piping, ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, rooting depth.
Dn: Dearborn	Moderate: seepage.	Severe: piping, large stones.	Severe: no water.	Deep to water	Large stones, erodes easily.	Large stones, erodes easily, droughty.
Dr: Dearborn	Moderate: seepage.	Severe: piping, large stones.	Severe: no water.	Deep to water	Large stones, too sandy.	Large stones, droughty.
EdF2: Eden	Severe: slope.	Severe: hard to pack, large stones.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
EeE2: Eden	Severe: slope.	Severe: hard to pack, large stones.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
EkA: Elkinsville	Moderate: seepage.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
EkB-----------Elkinsville	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Hu-----------Huntington	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
MaB2-----------Markland	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MaC2-----------Markland	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Ne-----------Newark	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
PaE2-----------Pate	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, large stones, erodes easily.	Slope, erodes easily, droughty.
PkB-----------Pekin	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness.	Erodes easily, rooting depth.
RoA-----------Rossmoyne	Moderate: seepage.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness.	Erodes easily, rooting depth.
RoB2-----------Rossmoyne	Moderate: seepage, slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.
SwB2-----------Switzerland	Moderate: seepage, slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
SwC2-----------Switzerland	Severe: slope.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Ud. Udorthents						
WgB2-----------Weisburg	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily, rooting depth.	Erodes easily, rooting depth.
WgC2-----------Weisburg	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, rooting depth.	Slope, erodes easily, rooting depth.
WhA-----------Wheeling	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
WhB-----------Wheeling	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
WhC, WhE-----------Wheeling	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope.
WvC-----------Woolper	Moderate: seepage.	Severe: hard to pack.	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AvA, AvB2-------- Avonburg	0-9	Silt loam--------	CL, ML, CL-ML	A-4	0	100	100	95-100	75-95	20-30	2-10
	9-17	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	75-95	30-45	10-20
	17-70	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0-3	95-100	95-100	90-100	70-95	30-45	10-20
	70-80	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-3	95-100	90-100	75-95	60-85	30-45	10-20
BmC-------------- Bloomfield	0-9	Loamy fine sand	SM, SP, SP-SM	A-2-4, A-3	0	100	100	70-90	4-35	---	NP
	9-49	Fine sand, loamy fine sand, sand.	SP, SM, SP-SM	A-2-4, A-3	0	100	100	70-90	4-35	---	NP
	49-60	Fine sand, loamy fine sand, fine sandy loam.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	65-90	4-35	<20	NP-3
BoC2, BoE2------- Bonnell	0-7	Silty clay loam	CL	A-6	0	95-100	95-100	85-100	65-90	30-40	11-16
	7-18	Silty clay, clay, clay loam.	CH	A-7	0	95-100	95-100	90-100	75-95	50-65	30-40
	18-65	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	60-80	30-60	15-35
	65-80	Clay loam, loam	CL	A-6, A-7	0-10	95-100	90-100	85-95	60-80	30-50	15-30
CaC2, CaC3------- Carmel	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	25-45	10-20
	7-34	Clay, silty clay	CH	A-7	0-10	100	100	90-100	75-100	50-65	30-40
	34-45	Flaggy clay, very flaggy silty clay, very channery clay.	CL, CH	A-7	40-80	85-100	85-100	80-100	65-95	40-60	18-32
	45	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ch--------------- Chagrin	0-9	Silt loam--------	ML, CL, CL-ML	A-4	0	95-100	85-100	80-100	70-90	20-35	2-10
	9-43	Silt loam, loam, sandy loam.	ML, SM	A-4, A-2, A-6	0	90-100	75-100	55-90	30-80	20-40	NP-14
	43-60	Stratified silt loam to channery fine sand.	ML, SM	A-4, A-2	10-30	85-100	75-100	50-85	15-80	20-40	NP-10
CnB2, CnC2, CnC3- Cincinnati	0-8	Silt loam--------	ML, CL	A-4, A-6	0	100	100	90-100	80-100	25-40	3-16
	8-27	Silty clay loam, loam, silt loam.	CL	A-6, A-4	0	95-100	90-100	90-100	70-100	25-40	8-15
	27-64	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	95-100	85-95	75-90	65-80	25-40	6-20
	64-80	Clay loam, loam	CL, ML, CL-ML	A-6, A-4	0	95-100	85-95	75-90	65-80	25-40	5-20
Co--------------- Cobbsfork	0-11	Silt loam--------	CL, ML, CL-ML	A-4	0	100	100	90-100	70-90	15-30	3-10
	11-32	Silt loam--------	CL, ML, CL-ML	A-4	0	100	100	90-100	70-95	15-30	3-10
	32-65	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-95	20-35	5-15
	65-80	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-95	20-35	5-15

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Dn---------------- Dearborn	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0-10	90-95	85-95	70-95	55-85	25-40	5-20
	10-15	Clay loam, silt loam, channery loam.	CL, SC	A-6, A-7	0-20	85-90	75-90	65-90	45-80	30-45	10-20
	15-60	Very channery loam, very channery clay loam, extremely channery coarse sandy loam.	CL-ML, CL, GC, SC	A-4, A-6, A-2-4, A-2-6	25-50	65-75	50-75	50-75	30-60	25-40	4-15
Dr---------------- Dearborn	0-5	Channery silt loam.	CL-ML, CL	A-4, A-6	0-10	65-80	55-75	50-75	40-65	25-35	6-12
	5-19	Clay loam, channery loam, very channery loamy coarse sand.	CL, ML, CL-ML, SM	A-6, A-4, A-2	5-20	80-90	70-90	60-85	30-80	20-40	3-16
	19-60	Very channery loam, very channery coarse sandy loam, very flaggy loamy sand.	CL-ML, CL, SM, SC	A-4, A-6, A-2-4, A-2-6	25-50	65-75	45-70	45-70	30-60	20-40	3-16
EdF2-------------- Eden	0-5	Flaggy silt loam	CL, CH	A-7, A-6	25-40	75-100	70-100	70-100	65-95	35-65	12-35
	5-26	Flaggy silty clay, flaggy clay, silty clay.	CH, CL	A-7	10-45	75-100	55-100	50-100	50-95	45-75	20-45
	26	Weathered bedrock	---	---	---	---	---	---	---	---	---
EeE2-------------- Eden	0-6	Silty clay loam	CL, CH	A-7, A-6	0-15	85-100	80-100	75-100	70-100	35-65	12-35
	6-26	Flaggy silty clay, flaggy clay, silty clay.	CH, CL	A-7	10-45	75-100	55-100	50-100	50-95	45-75	20-45
	26	Weathered bedrock	---	---	---	---	---	---	---	---	---
EkA, EkB---------- Elkinsville	0-10	Silt loam--------	CL-ML, ML	A-4	0	100	100	90-100	70-90	<25	NP-7
	10-68	Silty clay loam, silt loam.	CL	A-6, A-4	0	100	100	85-100	65-90	20-35	7-15
	68-80	Loam, sandy clay loam, silt loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	100	90-100	75-100	45-80	20-35	5-15
Hu---------------- Huntington	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	60-95	25-40	5-15
	8-80	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	60-95	25-40	5-15
MaB2, MaC2-------- Markland	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	8-60	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-95	45-60	19-32
Ne---------------- Newark	0-15	Silt loam--------	ML, CL, CL-ML	A-4	0	95-100	90-100	80-100	55-95	<32	NP-10
	15-35	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	95-100	90-100	85-100	70-98	22-42	3-20
	35-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0-3	75-100	70-100	65-100	55-95	22-42	3-20

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PaE2------------- Pate	0-5	Silt loam--------	CL	A-4, A-6 A-7	0-5	90-100	85-100	80-100	70-100	25-50	8-18
	5-46	Silty clay loam, silty clay, clay.	CL, CH	A-7	0-5	90-100	85-100	80-100	70-100	45-65	25-40
	46-55	Channery silty clay loam, very flaggy clay.	CL, CH	A-6, A-7	5-40	75-100	70-100	65-100	60-95	25-55	10-30
	55	Weathered bedrock	---	---	---	---	---	---	---	---	---
PkB-------------- Pekin	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	85-100	65-100	20-30	5-15
	13-22	Silt loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-100	25-40	10-20
	22-43	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	88-98	65-90	25-35	5-15
	43-60	Stratified fine sandy loam to silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	80-95	50-85	20-40	5-15
RoA, RoB2-------- Rossmoyne	0-9	Silt loam--------	ML	A-4	0	90-100	90-100	90-100	85-100	30-40	4-10
	9-22	Silty clay loam, silt loam, clay loam.	CL, ML	A-6, A-7, A-4	0	90-100	90-100	85-100	75-95	30-48	8-20
	22-60	Clay loam, loam, silty clay loam.	CL	A-6, A-4	0	90-100	85-95	80-90	70-85	25-40	9-19
	60-80	Clay loam, loam, silt loam.	CL	A-6, A-7, A-4	0	80-95	70-90	65-85	60-80	25-42	8-20
SwB2, SwC2------- Switzerland	0-10	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	80-100	20-40	5-15
	10-28	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-100	25-45	15-25
	28-65	Silty clay, clay, channery silty clay loam.	CL, CH	A-7, A-6	0-15	95-100	70-100	65-100	55-95	45-70	25-40
	65	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ud. Udorthents											
WgB2, WgC2------- Weisburg	0-7	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-40	4-15
	7-28	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-95	25-40	4-15
	28-56	Silt loam, silty clay loam, clay loam.	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	65-95	25-40	5-15
	56-80	Silty clay, clay	CH	A-7	0	95-100	90-100	80-100	60-95	50-70	25-40
WhA, WhB, WhC, WhE------------- Wheeling	0-11	Loam-------------	ML, CL, SM, SC	A-4	0	90-100	90-100	85-100	45-90	15-35	NP-10
	11-58	Silty clay loam, loam, gravelly sandy loam.	ML, CL, SM, SC	A-4, A-6	0-5	90-100	70-100	65-100	45-80	20-40	2-20
	58-80	Stratified fine sandy loam to sand and gravel.	GM, SM, GP, GW	A-1, A-2, A-3, A-4	10-20	35-90	20-75	10-65	5-45	<20	NP-10
WvC-------------- Woolper	0-5	Silty clay loam	CL	A-6, A-7	0-10	95-100	90-100	85-100	75-100	34-42	15-22
	5-57	Silty clay, silty clay loam, clay.	CL, CH	A-7, A-6	0-10	95-100	90-100	85-100	75-100	35-65	15-40
	57-60	Clay, silty clay	CH, CL	A-7	0-10	95-100	90-100	85-100	75-100	45-75	20-45

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
AvA, AvB2--------	0-9	10-18	1.30-1.45	0.6-2.0	0.20-0.24	4.5-7.3	Low-----------	0.43	4	5	.5-2
Avonburg	9-17	22-30	1.35-1.50	0.6-2.0	0.18-0.20	4.0-5.5	Moderate-----	0.43			
	17-70	22-30	1.60-1.85	<0.06	0.06-0.08	4.0-6.0	Moderate-----	0.43			
	70-80	14-30	1.50-1.70	<0.06	0.06-0.10	4.5-8.4	Moderate-----	0.43			
BmC--------------	0-9	5-10	1.50-1.70	6.0-20	0.10-0.12	5.1-7.8	Low-----------	0.15	5	2	.5-2
Bloomfield	9-49	2-10	1.60-1.80	6.0-20	0.06-0.11	5.1-7.3	Low-----------	0.15			
	49-60	5-13	1.60-1.80	2.0-20	0.05-0.10	5.1-7.8	Low-----------	0.15			
BoC2, BoE2-------	0-7	27-32	1.30-1.50	0.2-0.6	0.17-0.23	4.5-7.3	Moderate-----	0.43	3	5	.5-3
Bonnell	7-18	40-60	1.50-1.70	0.06-0.2	0.09-0.13	4.5-6.0	High----------	0.32			
	18-65	27-40	1.45-1.60	0.2-0.6	0.14-0.19	4.5-8.4	Moderate-----	0.32			
	65-80	25-40	1.45-1.60	0.2-0.6	0.08-0.15	6.1-8.4	Moderate-----	0.32			
CaC2, CaC3-------	0-7	27-40	1.40-1.60	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.43	4	7	1-3
Carmel	7-34	50-60	1.55-1.75	<0.06	0.09-0.11	4.5-7.3	High----------	0.32			
	34-45	40-55	1.55-1.75	<0.06	0.03-0.08	7.4-8.4	Moderate-----	0.32			
	45	---	---	---	---	---	-------------	----			
Ch---------------	0-9	10-27	1.20-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.32	5	5	2-4
Chagrin	9-43	18-30	1.20-1.50	0.6-2.0	0.14-0.20	5.6-7.8	Low-----------	0.32			
	43-60	5-25	1.20-1.40	0.6-2.0	0.08-0.20	6.6-7.8	Low-----------	0.32			
CnB2, CnC2, CnC3-	0-8	15-25	1.30-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low-----------	0.37	4-3	6	1-3
Cincinnati	8-27	22-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Low-----------	0.37			
	27-64	24-35	1.60-1.85	0.06-0.2	0.08-0.12	4.5-6.5	Moderate-----	0.37			
	64-80	24-40	1.55-1.75	0.06-0.2	0.08-0.12	4.0-6.5	Moderate-----	0.37			
Co---------------	0-11	8-18	1.30-1.60	0.06-0.2	0.22-0.24	4.5-7.3	Low-----------	0.37	4	5	1-3
Cobbsfork	11-32	8-22	1.30-1.60	0.06-0.2	0.20-0.22	4.5-6.5	Low-----------	0.37			
	32-65	15-28	1.40-1.85	<0.06	0.06-0.12	4.5-6.0	Low-----------	0.37			
	65-80	17-28	1.40-1.65	0.06-0.2	0.06-0.12	4.5-6.5	Low-----------	0.37			
Dn---------------	0-10	20-27	1.30-1.45	0.6-2.0	0.17-0.21	7.4-8.4	Low-----------	0.37	3	5	1-3
Dearborn	10-15	20-35	1.40-1.60	0.6-2.0	0.13-0.17	7.4-8.4	Low-----------	0.28			
	15-60	20-35	1.50-1.75	0.6-6.0	0.05-0.07	7.4-8.4	Low-----------	0.28			
Dr---------------	0-5	20-27	1.30-1.45	0.6-2.0	0.12-0.15	7.4-8.4	Low-----------	0.28	3	5	1-3
Dearborn	5-19	8-35	1.35-1.60	0.6-2.0	0.10-0.17	7.4-8.4	Low-----------	0.28			
	19-60	8-35	1.50-1.65	0.6-6.0	0.05-0.07	7.4-8.4	Low-----------	0.28			
EdF2-------------	0-5	12-27	1.30-1.50	0.06-0.6	0.12-0.18	6.6-7.8	Moderate-----	0.17	3	8	.5-3
Eden	5-26	40-60	1.45-1.65	0.06-0.2	0.08-0.13	5.1-8.4	Moderate-----	0.28			
	26	---	---	---	---	---	-------------	----			
EeE2-------------	0-6	27-40	1.35-1.55	0.06-0.6	0.12-0.18	6.6-7.8	Moderate-----	0.43	3	7	.5-3
Eden	6-26	40-60	1.45-1.65	0.06-0.2	0.08-0.13	5.1-8.4	Moderate-----	0.28			
	26	---	---	---	---	---	-------------	0.17			
EkA, EkB---------	0-10	7-18	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.37	5	5	.5-2
Elkinsville	10-68	19-30	1.40-1.60	0.6-2.0	0.18-0.22	4.5-6.5	Moderate-----	0.37			
	68-80	16-30	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Moderate-----	0.37			
Hu---------------	0-8	18-30	1.10-1.30	0.6-2.0	0.18-0.24	5.6-7.8	Low-----------	0.28	5	6	3-6
Huntington	8-80	18-30	1.30-1.50	0.6-2.0	0.16-0.22	5.6-7.8	Low-----------	0.32			
MaB2, MaC2-------	0-8	20-27	1.30-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.43	3	5	1-3
Markland	8-60	40-55	1.55-1.70	0.06-0.2	0.11-0.13	5.1-8.4	High----------	0.32			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Ne------------- Newark	0-15	7-27	1.20-1.40	0.6-2.0	0.15-0.23	5.6-7.8	Low----------	0.43	5	5	1-4
	15-35	18-35	1.20-1.45	0.6-2.0	0.18-0.23	5.6-7.8	Low----------	0.43			
	35-60	12-40	1.30-1.50	0.6-2.0	0.15-0.22	5.6-7.8	Low----------	0.43			
PaE2----------- Pate	0-5	20-27	1.35-1.50	0.2-0.6	0.22-0.24	5.6-7.3	Moderate-----	0.37	3	6	1-4
	5-46	35-55	1.50-1.70	<0.06	0.08-0.16	5.6-7.3	High---------	0.37			
	46-55	35-55	1.60-1.80	<0.06	0.05-0.12	6.1-8.4	High---------	0.37			
	55	---	---	---	---	---	-------------	----			
PkB------------ Pekin	0-13	15-26	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.43	4	5	1-3
	13-22	25-35	1.40-1.60	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.43			
	22-43	22-30	1.60-1.80	<0.06	0.06-0.08	4.0-6.5	Low----------	0.43			
	43-60	20-34	1.40-1.60	0.6-2.0	0.06-0.08	4.5-7.3	Low----------	0.43			
RoA, RoB2------ Rossmoyne	0-9	13-27	1.35-1.50	0.6-2.0	0.20-0.24	4.5-7.3	Low----------	0.37	4	6	1-3
	9-22	22-35	1.40-1.60	0.6-2.0	0.14-0.19	4.5-6.5	Moderate-----	0.37			
	22-60	24-35	1.70-1.90	0.06-0.2	0.06-0.10	4.0-5.5	Moderate-----	0.37			
	60-80	18-45	1.60-1.75	0.06-0.2	0.06-0.10	5.1-7.3	Moderate-----	0.37			
SwB2, SwC2----- Switzerland	0-10	20-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.43	4	5	.5-3
	10-28	25-35	1.40-1.65	0.6-2.0	0.18-0.22	4.5-6.0	Moderate-----	0.43			
	28-65	55-70	1.35-1.60	<0.06	0.09-0.13	4.5-8.4	High---------	0.32			
	65	---	---	---	---	---	-------------	----			
Ud. Udorthents											
WgB2, WgC2----- Weisburg	0-7	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	4	6	1-2
	7-28	18-35	1.35-1.50	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.37			
	28-56	18-35	1.55-1.80	<0.06	0.06-0.08	4.5-5.5	Moderate-----	0.37			
	56-80	40-65	1.50-1.70	<0.06	0.08-0.14	5.6-6.5	High---------	0.32			
WhA, WhB, WhC, WhE----------- Wheeling	0-11	12-20	1.20-1.40	0.6-6.0	0.12-0.18	5.1-6.0	Low----------	0.37	4	5	.5-1
	11-58	18-30	1.30-1.50	0.6-2.0	0.08-0.16	5.1-6.0	Low----------	0.32			
	58-80	8-15	1.30-1.50	6.0-20	0.04-0.08	5.1-6.0	Low----------	0.20			
WvC------------ Woolper	0-5	27-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-7.8	Low----------	0.37	3	7	4-6
	5-57	36-50	1.30-1.55	0.2-2.0	0.13-0.19	6.1-7.8	Moderate-----	0.28			
	57-60	40-60	1.45-1.65	0.2-0.6	0.12-0.17	6.1-7.8	Moderate-----	0.28			

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
AvA, AvB2--------- Avonburg	D	None---------	---	---	1.0-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	High.
BmC--------------- Bloomfield	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
BoC2, BoE2-------- Bonnell	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
CaC2, CaC3-------- Carmel	C	None---------	---	---	>6.0	---	---	>40	Soft	Moderate	High-----	Moderate.
Ch---------------- Chagrin	B	Occasional	Brief-----	Nov-May	4.0-6.0	Apparent	Feb-Mar	>60	---	Moderate	Low------	Moderate.
CnB2, CnC2, CnC3-- Cincinnati	C	None---------	---	---	2.5-4.0	Perched	Jan-Apr	>60	---	High-----	Moderate	High.
Co---------------- Cobbsfork	D	None---------	---	---	+.5-1.0	Perched	Dec-Apr	>60	---	High-----	High-----	High.
Dn, Dr------------ Dearborn	B	Frequent----	Very brief	Nov-Mar	>6.0	---	---	>60	---	Moderate	Low------	Low.
EdF2, EeE2-------- Eden	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
EkA, EkB---------- Elkinsville	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
Hu---------------- Huntington	B	Occasional	Brief-----	Dec-May	>6.0	---	---	>60	---	High-----	Low------	Moderate.
MaB2, MaC2-------- Markland	C	None---------	---	---	3.0-6.0	Perched	Mar-Apr	>60	---	Moderate	High-----	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ne----------------- Newark	C	Occasional	Brief-----	Jan-Apr	0.5-1.5	Apparent	Dec-May	>60	---	High-----	High-----	Low.
PaE2--------------- Pate	C	None---------	---	---	>6.0	---	---	>50	Soft	Moderate	High-----	Moderate.
PkB---------------- Pekin	C	Rare---------	---	---	2.0-6.0	Apparent	Mar-Apr	>60	---	High-----	Moderate	High.
RoA, RoB2--------- Rossmoyne	C	None---------	---	---	1.5-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	High.
SwB2, SwC2-------- Switzerland	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
Ud. Udorthents												
WgB2, WgC2-------- Weisburg	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
WhA, WhB, WhC, WhE-------------- Wheeling	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
WvC---------------- Woolper	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate that data were not available. MAX means maximum dry density; OPT, optimum moisture; LL, liquid limit; PI, plasticity index; and UN, Unified]

Soil name and location	Parent material	Report number S81-IN-155	Depth	Moisture density		Percentage passing sieve--				Percentage smaller than--				LL	PI	Classification	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft^3	Pct									Pct			
Bonnell silty clay loam: 850 feet north and 2,500 feet west of the southeast corner of sec. 34, T. 5 N., R. 12 E.	About 11 inches of loess over glacial till.	1-1	0-7	105	19	98	98	95	80	---	---	---	23	34	12	A-6	CL
		1-4	18-27	100	22	98	97	95	79	---	---	---	42	58	34	A-7-6	CH
		1-8	65-80	117	14	97	96	88	70	---	---	---	26	33	18	A-6	CL
Carmel silty clay loam: 1,750 feet north and 2,200 feet east of the southwest corner of sec. 11, T. 2 N., R. 3 W.	About 7 inches of loess over residuum and bedrock.	9-1	0-7	101	21	100	100	99	96	---	---	---	27	35	13	A-6	CL
		9-3	14-26	91	29	100	100	100	97	---	---	---	58	63	31	A-7-5	CH
		9-5	34-45	102	22	88	85	81	76	---	---	---	38	47	20	A-7-6	CL
Eden flaggy silt loam: 1,600 feet south and 2,300 feet east of the northwest corner of sec. 2, T. 5 N., R. 12 E.	Interbedded limestone and shale residuum over bedrock.	2-1	0-5	91	27	100	100	99	94	---	---	---	28	47	16	A-7	CL
		2-3	11-20	99	24	97	97	96	94	---	---	---	51	48	21	A-7	CL
Pate silt loam: 200 feet south and 400 feet west of the northeast corner of sec. 16, T. 2 N., R. 3 W.	Interbedded limestone and shale residuum over bedrock.	11-1	0-5	95	25	100	100	100	98	---	---	---	32	46	17	A-7	CL
		11-3	15-25	103	22	100	100	100	97	---	---	---	42	44	22	A-7	CL
		11-6	46-55	106	19	95	95	95	91	---	---	---	34	40	18	A-6	CL
Switzerland silt loam: 750 feet west and 1,450 feet south of the northeast corner of sec. 18, T. 2 N., R. 3 W.	About 28 inches of loess over interbedded limestone and shale residuum.	10-1	0-10	101	20	100	100	100	98	---	---	---	19	34	10	A-4	CL
		10-2	10-20	104	19	100	100	100	99	---	---	---	32	37	17	A-6	CL
		10-6	38-48	89	31	100	100	99	96	---	---	---	63	69	40	A-7	CL
		10-7	48-65	108	19	98	97	90	82	---	---	---	34	40	19	A-6	CL

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Avonburg	Fine-silty, mixed, mesic Aeric Fragiaqualfs
*Bloomfield	Sandy, mixed, mesic Psammentic Hapludalfs
Bonnell	Fine, mixed, mesic Typic Hapludalfs
Carmel	Fine, vermiculitic, mesic Typic Hapludalfs
Chagrin	Fine-loamy, mixed, mesic Dystric Fluventic Eutrochrepts
*Cincinnati	Fine-silty, mixed, mesic Typic Fragiudalfs
Cobbsfork	Fine-silty, mixed, mesic Typic Ochraqualfs
Dearborn	Loamy-skeletal, mixed, mesic Fluventic Hapludolls
Eden	Fine, mixed, mesic Typic Hapludalfs
Elkinsville	Fine-silty, mixed, mesic Ultic Hapludalfs
Huntington	Fine-silty, mixed, mesic Fluventic Hapludolls
Markland	Fine, mixed, mesic Typic Hapludalfs
Newark	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Pate	Fine, illitic, mesic Typic Hapludalfs
Pekin	Fine-silty, mixed, mesic Aquic Fragiudalfs
Rossmoyne	Fine-silty, mixed, mesic Aquic Fragiudalfs
*Switzerland	Fine-silty over clayey, mixed, mesic Typic Hapludalfs
Udorthents	Loamy, mixed, mesic Udorthents
Weisburg	Fine-silty, mixed, mesic Typic Fragiudalfs
Wheeling	Fine-loamy, mixed, mesic Ultic Hapludalfs
Woolper	Fine, mixed, mesic Typic Argiudolls

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